

S-COM 6K

MICROPROCESSOR REPEATER CONTROLLER

OWNER'S MANUAL

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(V2.0 upgrade in back)

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IMPORTANT!

1. This product uses CMOS integrated circuits and other components that can be damaged by static electricity. Be sure that you are properly and safely grounded, and are working at a static-free workstation, when handling these components.
2. This product uses a lithium battery to provide power to the memory system when main power is interrupted. This lithium battery is a primary cell. Do not attempt to recharge it!
3. The pin designations of the DB25 connector in the 6K are slightly different than the pin designations of the DB25 connector in the 5K. Specifically, pins 16 and 18 are active signals in the 6K; these pins are connected to ground in the 5K. Be sure you have checked your cable and removed connections from pins 16 and 18 if you are replacing a 5K controller with a 6K controller!

DESCRIPTION

1. INTRODUCTION

The S-COM 6K is a high-quality, compact, microprocessor-based repeater controller intended for use in amateur radio and commercial radio installations. Incorporating advanced hardware and software designs, the 6K provides most-often-needed control functions **and** powerful new features not found in any comparable-cost controller.

The 6K is fully remotely programmable with DTMF commands via the telephone or via the receiver ports, thus eliminating the inconvenience of returning EPROMs, microcontroller ICs, and PC boards to the factory for reprogramming. No jumpers or diodes are needed for programming. Data is retained in non-volatile memory, ensuring that no information is lost during power outages . . . making extra trips to the repeater site unnecessary.

2. STANDARD FEATURES

A. HARDWARE

a. Configuration

The standard 6K controller package consists of a Main Board and a Telephone Interface Module mounted in a rackmount cabinet. A set of mating connectors and a manual complete the basic package.

b. Cabinet

The cabinet provides mounting for the Main Board, the Telephone Interface Module Board, and up to two optional Audio Delay Module Boards. The cabinet can be installed in a standard 19" wide equipment rack. The cabinet is constructed from three basic parts: An iridite-plated chassis box, an iridite-plated chassis cover, and a black anodized front panel. The cabinet occupies 1-3/4" of vertical rack height, and measures about 7" deep. This shallow cabinet may be installed in any rack, including the slim Motorola rack cabinets.

c. Main Board

The 6K Main Board measures 6" deep by 8" wide, and can operate as a stand-alone controller. The digital portion of the board contains the microprocessor, memory, and logic input/output circuits. The analog portion contains the DTMF encoder/decoder, audio crosspoint switch, tone synthesis, and audio interface circuits. Two connectors, a DB25 female and a 2.5-mm DC power jack, are mounted on the Main Board. These connectors protrude through cutouts in the rear of the cabinet, allowing the interior of the cabinet to be free of wiring harnesses.

d. Telephone Interface Module

The Telephone Interface Module (TIM) is constructed on a 3" by 6" PC board, and adds Autopatch, Reverse Patch, and Phone Line Control capabilities to the 6K Main Board. It is registered with the FCC under Part 68 Rules, eliminating the need for a separate telephone

coupler. Transient protection and RFI filtering is provided. The all solid-state design of the TIM eliminates the possibility of mechanical relay failure, and the built-in electronic hybrid allows both half-duplex and full-duplex autopatch calls. The TIM supports both regenerated DTMF dialing and 10/20 PPS rotary dialing.

B. SOFTWARE

a. CW Identifier

The software CW Identifier stores remotely-programmable multiple call signs with ID Tail Messages. The interval between identifications is also programmable. The CW is internally mixed with repeat audio. The ID'er is "polite," which means that it attempts to identify only during breaks between transmissions.

b. CW Messages and Paging Formats

Most of the CW messages are remotely programmable. CW pitch and speed is programmable, and can even be changed within a message. The CW character set includes alphanumerics, punctuation, and a large library of "beeps." The CW amplitude level is set with a potentiometer.

The 6K supports single-tone (group call), two-tone sequential, 5/6-tone, and DTMF paging formats. Separate pots allow adjustment of tone paging and DTMF paging. Pages may be stacked for convenient call-ups of ARES members, weather spotters, DX Club members, on-the-air meetings, and so on.

c. Timers

All timers in the 6K are derived from the microprocessor's crystal-controlled clock circuit for improved accuracy over other methods. Most timers are remotely programmable, including the Courtesy Timer, Dropout Timer, Timeout timer, Autopatch Timer, etc.

d. Repeater Characteristics

The character of a repeater can be varied by choosing distinctive Courtesy Messages, Timeout Messages, Dropout Messages, and their associated timers. The repeater can be placed into one of several access modes, or disabled. These characteristics can be changed by command or by a transition detected by one of the logic inputs.

e. Clock and Calendar

A CW readout of the current time and date can be commanded. The clock can be read in either 12-hour or 24-hour format. An additional command is used to adjust the accuracy of the clock. (Power must be provided continuously to the controller for the clock and calendar to stay set).

f. Logic Inputs and Outputs

Logic inputs are used to detect a change of state in monitored devices at the repeater site. Logic outputs are manipulated by command to pulse or latch a controlled device at the site.

g. Command Language

Commands are given to the 6K with an easy-to-use DTMF language. Security is enhanced with a password system, as well as programmable restrictions on DTMF decode operation. A library of Macros may be defined for the repeater's users. Macros may be created, deleted, renamed, and modified at any time by authorized control operators.

3. OPTIONAL FEATURES

Audio Delay Module

The Audio Delay Module (model ADM/K) is constructed on a 2.1" by 2.7" PC board. It removes squelch noise bursts and DTMF tone bursts from received audio. Up to two ADMs may be installed in the 6K cabinet, one each for receiver #1 and receiver #2. The ADM will delay audio in the range of 50 to 150 milliseconds, adjustable via a potentiometer.

LIMITED WARRANTY

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

COVERAGE

Except as specified below, this warranty covers all defects in material and workmanship in this product. The following are not covered by the warranty:

1. Damage to, or deterioration of, the external cabinet.
2. Damage resulting from lightning, accident, misuse, abuse, or neglect.
3. Damage resulting from failure to follow instructions contained in your owner's manual.
4. Damage occurring during shipment of the product (claims must be presented to the carriers).
5. Damage resulting from repair or attempted repair by anyone other than S-COM Industries.
6. Damage resulting from causes other than product defects, including lack of technical skill, competence, or experience of the user.
7. Damage to any unit which has been altered or on which the serial number has been defaced, modified or removed.

ENFORCEMENT

This warranty may be enforced only by the original purchaser.

LENGTH OF WARRANTY

For both labor and parts, this warranty will be effective for one (1) year from the date of original purchase.

WHAT WE WILL PAY FOR

We will pay all labor and material expenses for items covered by the warranty. Payment of shipping charges is discussed in the next section of the warranty.

HOW YOU CAN GET WARRANTY SERVICE

Your unit must be serviced by S-COM's Service Department. **Please do not return your unit to the factory without prior authorization.** You must pay any shipping charges if it is necessary to ship the product to service. However, if the necessary repairs are covered by the warranty, we will pay the return shipping charges to any destination within the U.S. Whenever warranty service is

required, you must present the original dated invoice or a photocopy.

S-COM's liability for any defective products is limited to repair or replacement of the product, at S-COM's option.

S-COM reserves the right to make any changes in design or additions to, or improvements in, its products without any obligation to install such additions or improvements in equipment previously sold. S-COM further reserves the right to replace defective parts under warranty with different or improved parts.

This warranty is expressly in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness, and of all other obligations or liabilities on the part of S-COM.

THEORY OF OPERATION

1. INTRODUCTION

Great care was taken in the design of your controller to make it "installer-friendly." Audio and logical interfaces were made as universal in nature as possible, so that a minimum of external hardware is needed to complete the installation. Although the controller's "engine" is a powerful microprocessor, the command language is designed to be easy-to-learn and flexible.

2. PRE-PROGRAMMING (DEFAULTS)

The controller needs to know your repeater's call sign for its identifier; you must also tell it your choice of courtesy message, timeout timer, and so on.

You can program the controller on your workbench with an external DTMF pad and other devices to simulate the repeater. Or, you can install the controller in your repeater and program it through one of the receivers or the phone line.

To make the installation easier, the controller comes "pre-programmed" with certain **default** information stored in its non-volatile memory. When you have finished the installation, you may overwrite this default information by entering DTMF commands. If it ever becomes necessary to force the controller into its original default condition again, you can accomplish this by using the **initialize** pushbutton and a power-up sequence (the procedure is explained later). This procedure causes the microprocessor to read default information from the EPROM and write it over the old information stored in the non-volatile memory.

3. POWER REQUIREMENTS

Your controller has only a modest power requirement, which can be supplied by the repeater's own 12-volt power supply in most cases.

The controller's Main Board and Telephone Interface Module together require 12 to 15 volts DC at less than 100mA. (Do not exceed 15 VDC or damage may occur). The controller does not require regulated power, since it contains internal voltage regulators to create the necessary 10-volt DC audio supply and the 5-volt DC digital supply. A third supply of 4.5 volts DC is created from the 10V audio supply, and is used as the audio section's bias voltage.

4. REPEATER INTERFACING

Besides the power supply, the controller requires a minimum of four connections to the repeater. They are: (1) Receiver COR; (2) Receiver Audio; (3) Transmitter PTT; and (4) Transmitter Audio.

You must eliminate any paths that might bypass the controller. In other words, there must not be any connection from receiver audio to transmitter audio or from receiver COR to transmitter PTT except through the controller. Otherwise, the controller will not be able to fully take charge of repeater control functions.

If you require subaudible tone operation, you may connect a CTCSS decoder's output to the controller. The controller will then allow you to switch the repeater from carrier operation to one of

several CTCSS modes via DTMF commands.

5. 2nd RECEIVER INTERFACING

An additional receiver can be interfaced to your controller, which can act as either a link receiver or a control receiver. If a 2nd receiver is used, the controller requires a minimum of two additional connections. They are: (1) Receiver COR; and (2) Receiver Audio.

If you require subaudible tone operation for the 2nd receiver, you may connect a CTCSS decoder's output to the proper input on the controller.

NOTE: The two Receiver COR inputs, the two CTCSS Decoder inputs, and the Transmitter PTT output each has an associated dip switch on the Main Board. These switches are used to invert, or not invert, the appropriate signal. This means that the controller can accommodate either low-active or high-active signals.

6. EXTERNAL DEVICE INTERFACING

The controller has three Logic Inputs, each of which can monitor the state (ON or OFF) of an external device at the repeater site. Since you can program the controller to detect either a low-to-high transition or a high-to-low transition (or both), there is no need for the above-mentioned "invert" switches on these inputs.

You can monitor such sensors as power failure, a high-temperature detector, a high-water detector, or an intrusion alarm.

The controller also has three Logic Outputs, each of which can control (ON or OFF) an external device at the repeater site. Power MOSFETs are used as the switching devices, which are connected in an open-drain configuration (similar to transistors wired in an open-collector configuration).

Each output can sink 75mA when ON and withstand 40V when OFF. All three outputs are protected from transient damage.

7. AUDIO GATING

The controller uses an 8 by 12 analog crosspoint switch IC for audio gating. This IC operates under instructions from the microprocessor. Since all audio sources (receivers, tone generators, and the landline) are fed into the crosspoint switch, and since all audio loads (transmitter, tone decoder, and landline) are driven from the crosspoint switch, the controller's audio control flexibility far exceeds simpler designs.

8. TONE GENERATION

CW and paging tones are generated as square waves by the HD6340 Programmable Timer IC. These square waves are shaped by a transconductance amp stage to reduce the "thumping" characteristic heard on CW messages. (This thumping effect is caused by the DC component in the square wave pulse train). The tone is then filtered by a 6th-order, switched-capacitor, lowpass stage to yield sine waves. The filter is under microprocessor control and tracks the tone frequency. The result is a constant-amplitude sine wave tone that can be programmed to any desired

frequency in the range of 100 to 3000Hz, with an accuracy of a few Hertz. CW amplitude and paging amplitude are separately adjustable with pots.

DTMF characters are generated via the encoder portion of the MT8880 DTMF Transceiver IC. DTMF paging amplitude is pot-adjustable. DTMF dialing amplitude is not adjustable, and is fixed at the level set by FCC Part 68 regulations.

9. MEMORY PROTECTION

The controller contains circuitry to protect the data stored in RAM and maintain the data during power outages. A DS1210 IC monitors the 5-volt logic supply; when it detects an out-of-tolerance condition, the IC disables the RAM's chip-enable input. It switches the RAM's Vcc input from the logic supply to the lithium battery when the logic supply falls too low to maintain data integrity. The lithium battery has a lifetime of over 5 years (10 years if kept at room temperature), since the amount of current drawn by the RAM is very low under backup conditions (a few microamperes).

10. VOLTAGE MONITOR AND WATCHDOG TIMER

The controller contains circuitry to properly start the microprocessor when power is applied, to stop the microprocessor when power fails, and to restart the microprocessor if it gets into a runaway condition from a spike or transient.

A DS1232 IC monitors the 5-volt logic supply and asserts the microprocessor's reset input when the supply is out of tolerance. This method is superior to simple R/C reset circuits, which may not properly reset the CPU after voltage sags (brown-outs). The reset signal that is generated by the DS1232 drives not only the microprocessor but also other ICs to ensure that the controlled loads will be turned off, and that a graceful power-down sequence will be observed.

The DS1232 also monitors a software-generated "watchdog" signal. This signal is created at intervals by the execution of the microprocessor's software program. If the CPU fails to execute the program correctly, the watchdog signal will not be generated. The DS1232 will time out in less than one second if it does not receive the watchdog signal, and it will force the microprocessor to restart the program.

INSTALLATION

1. INTRODUCTION

You will need to prepare either one or two cables for your 6K controller. One cable is for DC power, and is terminated with the 2.5mm power plug provided. Since DC power may be supplied to the 6K via the other cable if desired, this first cable is optional. The 2.5mm power jack is retained in the 6K for the benefit of customers who are upgrading from existing 5K installations.

The other cable is for repeater connections, logic inputs and outputs, and so on. It is terminated with the DB25P 25-pin plug provided.

This section of the manual describes the proper connections to be made between your controller and your repeater equipment. It also describes the proper way to make the necessary audio level adjustment.

2. RECEIVER #1 (REPEATER RECEIVER) COR

Your 6K controller requires a logic signal, generated by your repeater receiver, which becomes active when an incoming carrier is detected. This logic signal is usually called "COR" (Carrier Operated Relay) or "COS" (Carrier Operated Switch), and is usually generated by the receiver's noise-operated squelch circuitry. Some receivers don't have an external COR or COS connection but do have a "channel busy" LED indicator, which works similarly.

At this point in our discussion, it is not important whether the COR signal is "low active" or "high active" (that is, whether the signal goes to a logic low condition or a logic high condition upon carrier detection), since the controller has sense-reversal DIP switches on the Main Board. These switches are discussed later.

To get a better understanding of how to interface your particular COR signal to the controller, let's examine the controller's COR input circuit. It's a general-purpose input circuit consisting of NPN transistor Q1C and a set of three resistors. (Q1 is actually a DIP package containing four 2N3904-type transistors. R11 is a DIP package containing seven separate 10K resistors. R12 is a SIP package containing seven 4.7K resistors with one side common.) Resistor R11F and the resistor on pin 7 of R12 together form a roughly three-to-one voltage divider. Q1C requires about 0.7VDC to turn on. Therefore, the COR input voltage threshold is about $3 \times 0.7V = 2.1V$. Your receiver's COR driver must be capable of generating a signal that swings above and below this 2V threshold as an incoming carrier is applied and removed, or it must have an "open-collector" type driver.

The third resistor from the group mentioned above is R13 (4.7K). R13 is a "pullup" resistor, and it's connected between the COR Input pin and the controller's +5V supply. The purpose of this pullup resistor is to provide input current for transistor Q1C in installations where the COR driver is an open-collector transistor or a pair of relay contacts ("dry" switching).

Now let's get down to specific interfaces. If your receiver's COR provides a pair of relay contacts to indicate carrier detection, then connect one contact to the controller's COR input and connect the other contact to ground.

If your receiver's COR provides an open-collector transistor or open-drain MOSFET, then connect your COR output directly to the controller's COR input.

Incidentally, note that some open-collector circuits will not pull down an input circuit all the way to ground (0V). This is normal. When OFF, these drivers are open (high impedance). When ON, the transistor driver will pull down to a few tenths of a volt above ground. If a Darlington transistor is used, the output is even higher above ground because of the Darlington's higher saturation voltage. If the controller were designed with a low-threshold COR input, it is possible for such driver circuits to keep the COR input "high" permanently. Remember that the 6K uses a voltage divider to raise the minimum threshold of the COR Input from 0.7V to 2.1V. As long as the receiver's COR output pulls down below 2V, the COR input will operate properly.

If your receiver's COR circuit sources a voltage from a logic gate or op amp comparator, then you may need to disconnect the COR Input's pullup resistor. Otherwise, it may interfere with the operation of the receiver COR by trying to pull it to +5V. You can check your installation by making the connection between the receiver COR output and the 6K COR input, then measuring the voltage at the COR input pin with both the receiver and controller powered up. If the voltage swings above and below the 2V threshold upon carrier detection, no problem exists. If the receiver COR

voltage is normally higher than 5V and is pulled down by the controller, or if the receiver COR cannot pull down the input below 2V, then you should clip one lead of the pullup resistor and lift it from the board to prevent its making contact.

The 6K's Repeater Receiver COR input is pin 6 of J2.

The last step is to determine the "sense" of your receiver's COR signal. Does the COR signal go "low" or "high" when an incoming carrier is detected? If the COR output goes "low" when a carrier is applied and returns "high" when the carrier is removed, then place dip switch #1 (part of S2) in the ON, (closed) position. If, however, the COR output goes "high" when a carrier is applied and returns "low" when the carrier is removed, then place dip switch #1 in the OFF (open) position.

3. REPEATER TRANSMITTER PTT

Your transmitter requires a "PTT" (Push-to-Talk) signal from the controller. When this signal becomes active, the transmitter will key (transmit). At this point, it is unimportant whether your transmitter's PTT input is "low active" or "high active", since the controller has sense-reversal dipswitches (discussed later). Your transmitter's PTT input should be connected to pin 10 of J2.

To get a better idea of how to interface your particular PTT input to the controller, we'll examine the controller's PTT output circuit. This circuit consists of a power MOSFET connected as an open-drain driver, plus a transient suppressor connected between the output and ground. The suppressor removes transients above about 30V, thereby protecting the MOSFET. The MOSFET is a large (8 Amp) device in a TO-220 package, but it was not selected for its high current capability. Rather, it was used because of its low ON resistance (less than 1 ohm), making it a nearly perfect switch.

The MOSFET's drain is connected to the PTT output, and its source is grounded. When turned on, the MOSFET appears to be a very low resistance between the output and ground. When turned off, the MOSFET appears to be a very high impedance, isolating the output from ground. Because of these characteristics, the PTT circuit can control transmitters with a variety of PTT inputs, from TTL-logic-compatible to large DC relay coils.

Some transmitters, including models made by Hamtronics, MELCO (Maggiore Electronic Laboratory), and RCA (500- and 700-series), use a powered PTT input arrangement, and cannot be keyed by an open-drain driver. These transmitters require a positive voltage to be sourced into their PTT inputs to key; removing the voltage unkeys the transmitter. The current requirement can be substantial.

A simple outboard circuit can be placed between the controller's PTT output and the transmitter's PTT input to satisfy these requirements. Connect a large PNP transistor so that its emitter goes to the transmitter's +12V supply, its collector goes to the transmitter's PTT input, and its base goes to the controller's PTT output through a 2K resistor (important). Connect a 4.7K resistor across the PNP transistor's base and emitter. If the transmitter draws little current through its PTT (500mA or less), you can use a 2N2904. If the transmitter draws 1 Amp or less, use a TIP30. When using this outboard circuit, place dipswitch #5 (part of S2) in the ON (closed) position. Skip the next paragraphs detailing dipswitch #5.

If you are building the outboard circuit described previously, you will need to place the PTT dipswitch in the ON position.

If you are driving your transmitter PTT directly from the controller, you must determine the "sense" of your transmitter's PTT input circuit. Does the transmitter key when the PTT input is driven "low," or does it key when the PTT input is driven "high?" (The majority of transmitters key when the PTT input is driven low).

If your transmitter keys when the PTT input is low, and unkeys when the PTT input is high (open circuit), then place dipswitch #5 (labeled "PTT", it's part of S2) in the ON (closed) position.

If, however, your transmitter keys when the PTT input is high (open circuit), and unkeys when the PTT input is low, then place dipswitch #5 in the OFF (open) position.

4. RECEIVER #1 (REPEATER RECEIVER) AUDIO

The controller requires audio from your repeater receiver, which should be connected to pin 13 of J2.

To get a better idea of how to interface your particular receiver's audio output to the controller, let's examine the controller's Receiver #1 audio input circuit.

This circuit consists of op amp U22D connected as an AC-coupled inverting amplifier with two feedback resistors and one feedback capacitor. A 50K pot, R75, serves as a level-adjust pot for the audio going into the op amp. The input impedance of this circuit depends upon the pot setting, but will be 14K ohms or greater.

The best place to get receiver audio is the output of the receiver's first audio preamp stage (usually the stage that follows the discriminator). This point is sometimes available at the "high" end of the volume control pot. The preamp stage usually provides flat (de-emphasized) audio, and the low impedance driving circuit (op amp or emitter-follower amplifier) can generate high-level audio while driving the capacitance of shielded cable. Don't tap into the wiper of the volume control pot, since accidental adjustment of the volume control will affect the repeat level. Tapping into the speaker driver as an audio source is discouraged, for the same reason. Also, speaker audio contains more distortion than audio from earlier stages.

The controller works best when driven with flat (de-emphasized) audio at a level of 700 mV rms (2 V peak-to-peak). If you provide this level, the controller's RX1 pot (R75) will be in the midrange position and optimum audio will be fed to the internal circuits. You can adjust the RX1 pot to accommodate other audio input levels. The controller's input acceptance range, as shipped from the factory, is 200mV rms (0.5 V p-p) to 2 V rms (5.6 V p-p).

If your receiver's audio output level is below 200mV, you can increase the gain of the controller's input by cutting a resistor. Feedback resistor R24 (100K) has one lead marked with a circled letter "A" on the PC board. You may cut this lead and lift the resistor to increase the gain by 3. The new input acceptance range will be 70 mV rms (0.2 V p-p) to 700 mV rms (2 V p-p). The midrange position of the RX1 pot will now correspond to 250 mV rms (0.7 p-p).

Some repeater owners will prefer to drive the controller with pre-emphasized audio directly from the receiver's discriminator. The controller must then de-emphasize the audio so that the audio feeding the DTMF decoder, phone line, etc. is flat. To accomplish de-emphasis, the controller's RX1 op amp stage must be modified to provide a -6 dB/octave rolloff response. A simple way to do this is to replace capacitor C45 (47 pF) with a 0.01 uF if the factory gain is used. Replace C45 with a 0.0047 uF if the triple-gain modification has been done. Note that using this larger capacitor will decrease the op amp's gain at increasing audio frequencies; you may need to make the increased-gain modification to offset the loss created by the de-emphasis capacitor.

After you have completed the repeater receiver audio interfacing, check the audio level at pin 14 of U22D. This is the output of the RX1 op amp. You should read about 700mV rms (2 V p-p) of audio when the receiver is fed a fully-deviated 1 KHz sine wave tone from a service monitor.

5. REPEATER TRANSMITTER AUDIO

Your transmitter will require audio from the controller. Connect the transmitter's audio input to pin 11 of the J2 connector on the controller.

To get a better idea of how to interface your particular transmitter's audio input to the controller's audio output, let's examine the circuit used in the controller to drive the Transmitter Audio Output.

This circuit consists of two cascaded op amp stages. The first op amp, U23D, is wired as an audio summer (mixer) and has three inputs from the audio crosspoint switch, U27. (The controller's software program can switch audio sources into these mixed inputs. One input would carry repeat audio, for example, while another would carry the CW ID tones).

The second op amp, U23A, is used as an audio driver. The output impedance of this stage is 600 ohms.

A 50k pot, R80, is connected between the two op amp stages and serves as the master gain pot for all transmitter audio.

The audio voltage that the driver develops across the transmitter audio input depends upon the load impedance presented by the transmitter's audio input. If the transmitter presents a load of 10K ohms or greater, the controller's audio output level will be adjustable from 200 mV rms (0.5 V p-p) to 2.4 V rms (6.7 p-p). If the transmitter presents a load of 600 ohms, the controller's audio output level will be adjustable from 100 mV rms (0.3 p-p) to 1.2 V rms (3.4 V p-p). Note that in most 600-ohms systems, the nominal level is 0 dBm (775 mV rms). This would correspond to the 85% clockwise position of pot R80.

In the above discussion, the lower voltage level corresponds to the 10% clockwise pot position. The higher voltage level corresponds to the 100% clockwise pot position.

If you are driving the microphone input, or some other low-level (sensitive) input stage in your transmitter, you will probably have to reduce the gain of the controller's audio driver stage. This can be accomplished by cutting a resistor. Resistor R59 (27K) is an input resistor to the second op amp, and has one lead marked with a circled letter "C" on the PC board. You may cut this lead and lift the resistor to decrease the gain by a factor of about 4. This modification decreases all audio sent to the transmitter.

If the transmitter presents a load of 10K ohms or greater, the controller's new audio output level will be adjustable from 55 mV rms (0.2 V p-p) to 580 mV rms (1.6 V p-p). If the transmitter presents a load of 600 ohms, the controller's audio output level will be adjustable from 27 mV rms (0.1 V p-p) to 290 mV rms (0.8 V p-p).

As before, the lower voltage level corresponds to the 10% clockwise pot position. The higher voltage level corresponds to the 100% clockwise pot position.

Although it is always a good idea to use shielded cable between the controller's audio connections and the repeater's audio connections, it is especially important to do so when driving sensitive microphone inputs in transmitters.

6. REPEATER CTCSS DECODER

CTCSS, or Continuous Tone-Controlled Squelch System, is a convenient problem solver for users and owners in many parts of the country where the bands are overcrowded with repeaters and RFI. In addition, your controller allows CTCSS to be required as a qualifier for entering DTMF commands, thus increasing the security of the repeater system.

Well-known trademarked names for CTCSS include "PL" and "Private Line" (Motorola), "Channel Guard" (General Electric), and "Call Guard" (Johnson). Your repeater may already have a CTCSS decoder built in, or you may wish to install one of the add-on boards readily available from a number of sources. A good example is the TS-32P from Communications Specialists, Inc., of Orange, CA (telephone 1-800-854-0547). The TS-32P is crystal-controlled for stability, and allows dipswitch selection of one of 32 CTCSS tone frequencies.

The CTCSS decoder should be installed in your repeater receiver following the instructions provided by the decoder manufacturer. You will need to connect the decoder's audio input directly to the receiver's discriminator output. The decoder provides a logic output, usually an open-collector transistor driver, which goes either "low" or "high" upon detection of CTCSS. This signal should be connected to pin 4 of the controller's J2 connector.

The controller's CTCSS Decoder input circuitry is designed exactly like the RX1 COR input. The transistor in this case is Q2A, the voltage divider is made up of R11B and the resistor on pin 4 of R12, and the pullup resistor is R15. You may wish to refer back to the "RECEIVER #1 COR" section of this manual for a discussion of the hardware design of the input circuit.

To check your CTCSS decoder interface, power up your receiver, CTCSS decoder, and the controller. Measure the voltage at pin 4 of J2. This voltage must swing above the 2.1 V threshold as the incoming CTCSS tone is applied and removed.

You must also determine the "sense" of your CTCSS decoder output. Does the output go "low" or "high" when the correct CTCSS tone is received? If the output goes "low" when the tone is detected and returns "high" when the tone is removed, then place dip switch #3 (part of S2) in the ON (closed) position. If, however, the output goes "high" when the tone is detected and returns "Low" when the tone is removed, then place dip switch #3 in the OFF (open) position.

7. RECEIVER #2 (CONTROL/LINK RECEIVER) COR

Your controller can be interfaced to a second receiver, if desired. This receiver can serve a number of applications, depending on your needs. Paths can be "set up" or "knocked down" between Receiver #2 and three devices: The transmitter, the DTMF decoder, and the phone line. Path control is done by DTMF commands. Allow a path between RX2 and the transmitter, and you now have a link receiver. Allow a path between RX2 and the DTMF decoder, and you now have a control receiver.

If you decide to add a second receiver, the controller will require a COR signal from it. Feed the COR into pin 5 of J2.

The controller's RX2 COR input circuitry is designed exactly like the RX1 COR input. The transistor in this case is Q2D, the voltage divider is made up of R11C and the resistor on pin 5 of R12, and the pullup resistor is R14. You may wish to refer back to the "RECEIVER #1 COR" section of this manual for a discussion of the hardware design of the input circuit.

To check your Receiver #2 COR interface, power up the receiver and the controller. Measure the voltage at pin 5 of J2. This voltage must swing above and below the 2.1 V threshold as the incoming carrier is applied and removed.

You must also determine the "sense" of your receiver #2 COR output. Does the output go "low" or "high" when a carrier is detected? If the output goes "low" when the carrier is detected and returns "high" when the carrier is removed, then place dip switch #2 in the ON (closed) position. If, however, the output goes "high" when the carrier is detected and returns "low" when the carrier is removed, then place dip switch #2 in the OFF (open) position.

IMPORTANT: If you are not using a second receiver, be sure dip switch #2 is in the ON (closed) position. This configures the RX2 COR input for a low-active COR signal. The pullup resistor on this input will hold the input high, thus making sure the controller does not see activity on this input.

8. RECEIVER #2 (CONTROL/LINK RECEIVER) AUDIO

If you decide to add a second receiver, the controller will require audio from it. RX2 Audio should be connected to pin 12 of the controller's J2 connector.

The controller's RX2 Audio input circuitry is designed exactly like the RX1 Audio input. The op amp in this case is U22C, and the level adjust pot is R76. The feedback resistor labeled R27 (100K) has a circled letter "B" near one lead on the PC board. You may cut this lead and lift the resistor to increase the gain by a factor of 3. If you are driving the RX2 audio input with pre-emphasized audio, replace C48 (47 pF) with a 0.01 uF if factory gain is used. Replace C48 with a 0.0047 uF if the increased gain modification has been done. You may wish to refer back to the "RECEIVER #1 AUDIO" section of this manual for a discussion of the hardware design of the audio input circuit.

After you have completed the Receiver #2 audio interfacing, power up both the receiver and the controller. Check the audio level at pin 8 of U22C. The level should be about 700 mV rms (2 V p-p) of audio when the receiver is fed a fully-deviated 1KHz sine wave tone from a service monitor.

9. RECEIVER #2 (CONTROL/LINK RECEIVER) CTCSS DECODER

If you decide to add a second receiver, you have the option of adding a CTCSS decoder to it. After installing the decoder into the receiver, connect the decoder's logic output to pin 16 of the controller's J2 connector.

The controller's RX2 CTCSS Decoder input circuitry is designed exactly like the RX1 COR input. The transistor in this case is Q1A, the voltage divider is made up of R11a and the resistor on pin 2 of R12, and the pullup resistor is R16. You may wish to refer back to the "RECEIVER #1 COR" section of this manual for a discussion of the hardware design of the input circuit.

To check your RX2 CTCSS decoder interface, power up the second receiver, its CTCSS decoder, and the controller. Measure the voltage at pin 16 of J2. This voltage must swing above and below the 2.1. V threshold as the incoming CTCSS tone is applied and removed.

You must also determine the "sense" of your CTCSS decoder output. Does the output go "low" or "high" when the correct CTCSS tone is received? If the output goes "low" when the tone is detected and returns "high" when the tone is removed, then place dip switch #4 (part of S2) in the ON (closed) position. If, however, the output goes "high" when the tone is detected and returns "low" when the tone is removed, then place dip switch #4 in the OFF (open) position.

10. DC POWER

Your controller has only a modest power requirement, which can be supplied by the repeater's own 12-volt power supply in most cases.

The controller's Main Board and Telephone Interface Module together require +12 to +15 volts DC at less than 100mA.

Do not exceed a supply voltage of +15 V! The controller's DC power input is protected by a 15-volt transient suppressor, which will start to draw current when the DC input voltage exceeds this limit.

The controller does not require a regulated power source, since it contains local voltage regulator ICs for powering its analog and digital circuits. However, your power source must be free of "sags" that may occur, for example, when the transmitter is keyed. Also, note that if significant ripple is present on the power source output, the ripple "peaks" must not exceed +15 V, and the ripple "valleys" must not fall below +12 V.

The controller contains circuitry to protect the data stored in memory during power outages. No external battery backup is needed to prevent loss of memory data. However, the controller cannot operate without external power, and owners may wish to provide backup power to both the repeater and the controller to ensure continuous service during utility power outages.

Power can be supplied to the controller via the 2.5 mm X 5.5 mm DC power plug (supplied). The center hold of the plug forms the positive (+) connection, and the sleeve forms the negative (-) connection.

Instead of using the 2.5 mm connector, you may supply power to the 6K via pin 18 of connector J2. You must shunt the 2-pin header labeled "P7" and "PWR" on the 6K Main Board.

The 2.5 mm DC power jack was retained in the 6K to allow easy upgrading of 5K installations to the 6K.

NOTE: Pin 18 of J2 is a ground pin in the 5K controller. Before shunting the P7/PWR header on the Main Board, be sure pin 18 is not connected to ground in your 5K cable.

Here's a special note to owners of alternatively-powered repeaters (solar, fuel cell, battery, etc.): Your controller is designed to behave predictably when the DC power input is slowly reduced! This behavior is important to prevent damage to the power source. For example, some controllers will suddenly stop operating (microprocessor reset) when a low voltage limit is reached. If an output, such as the transmitter PTT line, was enabled at the time, then the transmitter could stay keyed until the power source failed. Your S-COM controller will cease microprocessor operation when the power supply voltage fails, but it will also force the digital outputs off at that time. This condition will be held until the power source voltage drops considerably lower. With little load on the source, this should take a long time to occur.

11. LOGIC INPUTS

Your 6K controller has the ability to monitor "logical" devices at the repeater site. "Logical" devices are sensors, switches, relay contacts and other devices that have an off/on output.

The controller has three logic inputs dedicated to this purpose. Also, the two receiver COR inputs and the two CTCSS decoder inputs can serve as additional logic inputs.

Logic input #1 is pin 1 of J2. Logic input #2 is pin 2 of J2. Logic input #3 is pin 3 of J2.

Each logic input has a hardware circuit that is designed exactly like the RX1 COR input.

For Logic input #1, the transistor is Q1D, the voltage divider is made up of R11D and the resistor on pin 3 of R12, and the pullup resistor is R17.

For Log input #2, the transistor is Q2C, the voltage divider is made up of R11E and the resistor on pin 6 of R12, and the pullup resistor is R18.

For Logic input #3, the transistor is Q1B, the voltage divider is made up of R11G and the resistor on pin 8 of R12 and the pullup resistor is R19.

You may wish to refer back to the "RECEIVER #1 COR" section of this manual for a discussion of the hardware design of the input circuits.

To check your logic input interfaces, power up the sensor and the controller. Measure the voltage at the appropriate pin of the controller's J2 connector. This voltage must swing above and below the 2.1 V threshold as the sensor switches between its ON and OFF states.

The controller can detect both the low-to-high transition and the high-to-low transition of each logic input. Therefore, there is no need to for sense-reversal dipswitches on the three dedicated logic inputs.

Logic inputs are very handy for informing the controller (and the repeater's users) that some external condition has changed. Examples include detection of AC power failure, high water, high SWR, high temperature, intrusion, and so on.

The controller will execute macro commands upon sensing a change in state (transition) on its logic inputs. Since the owner programs the macro commands, he can control the action that the controller takes. This is a big improvement over controllers that take fixed action when an input is tripped, such as sending a fixed CW message.

12. LOGIC OUTPUTS

Your 6K controller has the ability to control "logical" devices at the repeater site. "Logical" devices are relays, lamps, solenoids, IC logic, and other devices that are turned ON and OFF.

The controller has three logic outputs dedicated to this purpose.

Logic output #1 is pin 7 of J2. Logic output #2 is pin 8 of J2. Logic output #3 is pin 9 of J2.

Each logic output has a hardware interface circuit that is designed exactly like the TX PTT output, except that the power MOSFET is smaller. You may wish to refer back to the "TRANSMITTER PTT" section of this manual for a discussion of the hardware design of the output circuits.

The power MOSFETs used as logic output drivers appear as 5-ohm resistances to ground when in the conducting state (ON). When ON, they can sink up to 75 mA. The MOSFETs appear open when in the non-conducting state (OFF). When OFF, they can withstand 40 VDC. Do not control loads over 40 VDC, since the transient protectors across the MOSFETs will start drawing current as the voltage increases beyond this limit.

Since the drain connections of the MOSFETs are brought out to the connector without "pullup" resistors, this configuration is called "open drain". This is similar to the "open collector" configuration used with bipolar transistors. An ohmmeter cannot be used to check the logic outputs, since no change will be seen when the outputs are switched between ON and OFF. A DC power source and a load of some type are needed to see the outputs change state.

Logic outputs are very handy for controlling external devices and appliances at the site. Examples of loads include lamps, LEDs, relays and other devices that operate from higher voltages (up to 40 VDC). If the loads are integrated or discrete logic devices that operate from 5V, you can make the logic outputs compatible by connecting pullup resistors of 3K ohms from the outputs to the 5 V power supply of the devices being driven. Other types of logic may require pullup resistors to +10 V or +12 V. Note that although the power MOSFETs are protected by transient suppressors in the controller, it is still important to wire diodes across inductive loads (such as relay coils and solenoid coils) in the non-conducting direction.

Each logic output can be latched ON or latched OFF. Each can also be momentarily turned ON or OFF. There is no need for sense-reversal dipswitches on the three logic outputs.

The controller will remember the state of each logic output during power outages. When power returns, the controller will turn each output ON or OFF to match its condition before the power loss. A "cold start" (initialization) will force all output OFF.

13. TELEPHONE LINE CONNECTION

If your controller is equipped with the Telephone Interface Module, you can connect the controller to the telephone network. The 14-foot cable supplied with your controller has a modular USOC (Universal Service Order Code) plug on each end. This plug mates with a USOC RJ11C jack. Connect one end of the cable to the controller, and the other end to the RJ11C jack at your repeater site.

The Telephone Interface Module is registered under Part 68 of the FCC rules and regulations for direct connection to the telephone line. A label is attached to the rear of the cabinet, listing the registration number and ringer equivalence. It reads:

Complies With Part 68, FCC Rules
FCC Registration No. GHZ37K-10180-DP-N
Ringer Equivalence: 1.3B

The Telephone Interface Module contains lightning protection circuitry. However, it is a good practice to install additional protection at the telephone line service entrance. The following companies market phone line suppressors:

Citel America, Inc.
1111 Parkcentre Blvd.
Suite 474
Miami, FL 33169
(305) 621 0022 (FL)
(800) 248-3548

ITW Linx Communications Prods
201 Scott St.
Elk Grove Village, IL 60007
(312) 952-8844
(312) 952-1633 (FAX)

Telebyte Technology, Inc.
270 East Pulaski Road
Greenlawn, NY 11740
(516) 385-8184 (FAX)
(800) 835-3298
(516) 423-3232

TII Industries, Inc.
1375 Akron St.
Copiague, NY 11726
(516) 789-5020 Sales
(516) 789-5000
Telex 144631

L-COM Data Products
1755 Osgood Street, Rte. 125
North Andover, MA 01845
(617) 682-6936
(617) 689-9484 (FAX)

MCG Electronics Inc.
12 Burt Drive
Deer Park, NY 11729
(516) 586-5125
Telex 645518

PolyPhaser Corporation
1425 Industrial Way
Gardnerville, NV 89410-1237
(800) 325-7170
(702) 782-4476 (FAX)
Telex 272718

L.E.A. Dynatech
12516 Lakeland Road
Santa Fe Springs, CA 90670
(213) 944-0916
(800) 654-8087
(213) 944-0781 (FAX)

FCC rules and regulations, Part 68 require the following information be provided to the user of FCC Registered Terminal equipment.

Section 68.100 GENERAL

Terminal equipment may be directly connected to the telephone network in accordance with the rules and regulations . . . of this part.

Section 68.104 STANDARD PLUGS AND JACKS

(a) General

"Except for telephone company-provided ringers, all connections to the telephone network shall be made through standard (USOC) plugs and standard telephone company-provided jacks, in such a manner as to allow for easy and immediate disconnection of the terminal equipment. Standard jacks shall be so arranged that if the plug connected thereto is withdrawn, no interference to the operation of the equipment at the customer's premises which remains connected to the telephone network shall occur by reason of such withdrawal."

Section 68.106 NOTIFICATION TO TELEPHONE COMPANY

"Customers connecting terminal equipment or protective circuitry to the telephone network shall, before such connection is made, give notice to the telephone company of the particular line (s) to which such connection is to be made, and shall provide to the telephone company the FCC Registration Number and Ringer Equivalence of the registered terminal equipment or protective circuitry. The customer shall give notice to the telephone company upon final disconnection of such equipment or circuitry from the particular line(s)."

Section 68.108 INCIDENCE OF HARM

"Should terminal equipment or protective circuitry cause harm to the telephone network, the telephone company shall, where practicable, notify the customer that temporary discontinuance of service may be required; however, where prior notice is not practicable, the telephone company may temporarily discontinue service forthwith, if such action is reasonable in the circumstances. In case of such temporary discontinuance, the telephone company shall:

(1) promptly notify the customer of such temporary discontinuance, (2) afford the customer the opportunity to correct the situation which gave rise to the temporary discontinuance, and (3) inform the customer of the right to bring a complaint to the Commission pursuant to the procedures set forth in Subpart E of this part."

Section 68.110 COMPATIBILITY OF THE TELEPHONE NETWORK AND TERMINAL EQUIPMENT.

(b) Changes in Telephone Company Facilities, Equipment, Operations or Procedures.

"The telephone company may make changes in its communications facilities, equipment, operations or procedures, where such action is reasonably required in the operation of its business and is not inconsistent with the rules and regulations in the Part. If such changes can be reasonably expected to render any customer's terminal equipment incompatible with telephone company communications facilities, or require modification or alteration of such

terminal equipment, or otherwise materially affect its use or performance, the customer shall be given adequate notice in writing, to allow the customer an opportunity to maintain uninterrupted service."

Section 68.216 REPAIR OF REGISTERED TERMINAL EQUIPMENT AND REGISTERED PROTECTIVE CIRCUITRY

"Repair of registered terminal equipment and registered protective circuitry shall be accomplished only by the manufacturer or assembler thereof or by their authorized agent; however, routine repairs may be performed by a user, in accordance with the instruction manual if the applicant certifies that such routine repairs will not result in noncompliance with the rules in Subpart D of this Part."

Section 68.218 (b) ADDITIONAL INSTRUCTIONS TO USER

1. ". . . registered terminal equipment or protective circuitry may not be used with party lines or coin lines."
2. ". . . when trouble is experienced the customer shall disconnect the registered equipment from the telephone line to determine if the registered equipment is malfunctioning, and . . . if the registered equipment is malfunctioning, the use of such equipment shall be discontinued until the problem has been corrected."
3. ". . . the user must give notice to the telephone company in accordance with the requirements of Section 68.106. . ."

14. INPUT/OUTPUT CONNECTOR SUMMARY

Both the 5K and the 6K models have DB25S (25-pin female D-subminiature) connectors on the main PC board. You may use the mating DB25P (male) connector (supplied) to build a cable, or you may purchase the optional pre-assembled cable. The cable will connect the controller to your repeater and auxiliary equipment.

CAUTION! The 5K has pins 16 and 18 grounded; the 6K uses these two pins for other signals.

The chart below shows the pinout for the 6K connector (J2), and the wire color codes used in the optional pre-assembled cable.

<u>PIN NO.</u>	<u>6K SIGNAL NAME</u>	<u>WIRE COLOR CODE</u>
1	Logic Input #1	Brown
2	Logic Input #2	Orange
3	Logic Input #3	Green
4	Receiver #1 CTCSS Decoder	Blue
5	Receiver #2 COR	Violet
6	Receiver #1 COR	Gray
7	Logic Output #1	White/Brown
8	Logic Output #2	White/Red
9	Logic Output #3	White/Orange
10	Transmitter PTT	White
11	Transmitter Audio	Orange (shielded)
12	Receiver #2 Audio	Yellow (shielded)
13	Receiver #1 Audio	Brown (shielded)
14	Ground	Black
15	Ground	Black
16	Receiver #2 CTCSS Decoder	Yellow
17	Ground	Black
18	DC Power Input	Red
19	Ground	Black
20	Ground	
21	Ground	
22	Ground	
23	Ground	(shield)
24	Ground	(shield)
25	Ground	(shield)

Pre-assembled cable: Connector on one end only. Wires are #24 gauge stranded. Shielded wires are #24 gauge stranded, shields connected to pins 23, 24, and 25. Cable is 4 feet in length.

15. POTENTIOMETER SUMMARY

The 6K Main Board is designed with 8 potentiometers. These pots adjust audio levels only. Tone frequencies, CW sending speed, and other parameters are digitally controlled and are remotely adjusted with DTMF commands. Therefore, the pots will only have to be adjusted when installing the controller, or when replacing the equipment to which the controller is interfaced.

POT NAME		PURPOSE
RX1	(R75)	Adjusts audio level from receiver #1 to controller
RX2	(R76)	Adjusts audio level from receiver #2 to controller
TX	(R80)	Adjusts master audio level from controller to transmitter
CW	(R77)	Adjusts level of CW (Morse) generator
PAGE	(R78)	Adjusts level of paging tone generator (1-tone, 2-tone, and 5/6-tone paging)
DTMF ENC	(R79)	Adjusts level of DTMF encoder to transmitter (DTMF paging)
LL-TX	(R81)	Adjusts level of landline (phone line AGC'd audio) to transmitter
LL-TT	(R82)	Adjusts level of landline (phone line non-AGC'd audio) to DTMF decoder

The Telephone Interface Module has no adjustment pots. Audio from the controller to the telephone line is controlled by AGC circuits to be within the levels required by FCC Part 68 rules and regulations.

16. SWITCH SUMMARY

The 6K Main Board has two switch assemblies, S1 and S2.

S1 is a momentary pushbutton switch used to initialize the controller. The procedure that must be used to initialize the controller is described later in this manual.

S2 is a 6-pole dipswitch array. Five of the switches are used to invert the sense of logical input signals. The sixth switch is used for special functions.

The five sense-reversal switches are described as follows:

- DIP SWITCH #1** - Inverts Receiver #1 COR Input
- DIP SWITCH #2** - Inverts Receiver #2 COR Input
- DIP SWITCH #3** - Inverts Receiver #1 CTCSS Decoder Input
- DIP SWITCH #4** - Inverts Receiver #2 CTCSS Decoder Input
- DIP SWITCH #5** - Inverts Transmitter PTT Output

A switch in the ON (closed) position means the input is "low" active. A switch on the OFF (open) position means the input is "high" active. Unused switches should be placed in the ON position.

GETTING STARTED

1. INTRODUCTION

In this section, we will assume that you have either completed the installation of the controller into the repeater, or you are simulating a repeater with switches for COR signals, LEDs for PTT loads, and so on.

If desired, the controller can be programmed on your workbench, then moved to the repeater site for installation. Be sure to transport the controller in anti-static packing material! Large electrostatic discharges can damage components and destroy the data stored in memory.

2. POWER ON/INITIALIZATION

Each time power is applied to the controller, it will check to see if the **Initialize** pushbutton is being pressed. (The Initialize pushbutton is located in the right rear corner of the Main Board). At that moment, the controller will decide whether to retrieve default information stored in the EPROM and write it into the non-volatile RAM (pushbutton down), or retain the previously-stored information (pushbutton up). If the pushbutton is pressed at any other time, it will have no effect. Since a specific sequence is needed to initialize your controller, accidental contact with the pushbutton will not destroy your programming efforts.

Controllers are initialized as part of the testing procedure at the factory. However, we recommend that you do another initialization before attempting to program the controller. There may be other occasions when you will need to initialize the controller. For example: (1) The programming password was never written down, and was forgotten by the programmer; (2) A general erasing of all programming is desired, since the controller is being transferred to a new repeater and will receive all new programming; (3) You are installing a new software upgrade EPROM; or (4), It has been necessary to replace the battery, RAM IC, RAM Controller IC, or some other part in the non-volatile RAM circuit. In this last case, you must perform the initialization sequence twice to ensure proper operation of the RAM Controller IC.

To initialize the controller, follow these four steps:

Step 1: Remove power from the controller. This can be done by pulling out the 2.5 mm DC power plug.

Step 2: Press and hold down the Initialize pushbutton.

Step 3: While holding down the pushbutton, restore power to the controller. This can be done by inserting the 2.5 mm DC power plug.

Step 4: Continue holding down the pushbutton for several seconds after the power has been restored.

An initialization is sometimes called a **cold start**. Applying power without doing an initialization is sometimes called a **warm start**. When a cold start occurs, the controller will send "? RES C" (reset, cold) in CW. When a warm start occurs, the controller will send "? RES" (reset) in CW.

After an initialization, we say that the controller's programming is in the **Default Condition**. Default conditions are necessary if we want the controller to be able to operate the repeater before we've had a chance to program it. An initialization can therefore be thought of as a quick "pre-programming" of the controller.

Most commands have default conditions. They are in effect until you change them through programming. The default conditions are described with the commands later in this manual.

NOTE: There is a push-on jumper in the Main Board that is used to disconnect the battery from the RAM IC. This jumper is removed during some repair operations, and during current drain tests. Removing this jumper **will not** initialize the controller! Removing and replacing the jumper will require an initialization sequence before proper operation will resume.

3. TESTING THE CONTROLLER-TO-REPEATER TRANSMITTER INTERFACE

Apply power to both the controller and the repeater while monitoring the repeater with an extra receiver. When power is applied, the transmitter should key and send the reset CW message. If the transmitter does not key at all, check the wiring. Both the controller and the repeater should be powered up. Check the connection between the controller's PTT output and the transmitter's PTT input. If the transmitter keying is acting "upside down" (unkeying during the message but keying afterwards), reverse the repeater transmitter PTT dipswitch.

If the transmitter is keying properly but no CW message is heard, check the wiring from the controller's Repeater Transmitter Audio Output to the transmitter's audio input. If the CW message is too loud or too soft, adjust the CW pot on the Main Board (see **Messages** section in this manual). Turn the pot clockwise to increase the level, and counter-clockwise to decrease the level.

If the CW message is still too loud with the pot turned nearly all the way down, you may be attempting to drive the microphone input of the transmitter instead of a later stage. If you cannot drive a later stage, then check the Transmitter Audio Output description in the installation section of this manual for information on decreasing the transmitter drive level.

4. TESTING THE CONTROLLER-TO-REPEATER RECEIVER INTERFACE

Generate an RF signal on the repeater's input frequency. The controller should key the repeater transmitter. When the signal disappears, a short courtesy beep should be heard. The transmitter should stay keyed for a few more seconds, then it should unkey. If this does not happen, check the wiring between the repeater receiver's COR driver and the controller's Receiver #1 COR Input. Check the voltage on the COR line to see if it swings above and below the required threshold. (Check the voltage with the controller and receiver connected, not just the open-circuit COR output from the receiver).

If the repeater is acting "upside down" (unkeying when a signal exists but keying afterwards), reverse the Receiver #1 COR dipswitch.

The default condition of the controller causes a 0.5-second delay between the loss of carrier and the courtesy beep. The transmitter will stay keyed for an additional 3.0-second dropout delay. These characteristics may all be changed later, so do not be concerned if this is not the way you wish the repeater to act.

Generate a modulated RF signal on the repeater's input frequency (a service monitor is quite helpful). Check the audio level as instructed in the Repeater Receiver Audio part of the Installation section. Check the transmitter for proper deviation, and adjust the Transmitter Audio Output pot as necessary.

5. TESTING THE DTMF DECODER

a. Introduction

Your controller uses an 8880-type DTMF Transceiver IC. This crystal-controlled device encodes and decodes all 16 DTMF digits. It has an extremely wide dynamic range (30 dB), and can detect digits that have as much as -6 dB to +6 dB of twist. ("Twist" refers to the difference in amplitude between the two individual tones that are summed to make up a DTMF digit. The more twist a system gives to DTMF digits, the more difficult it is to detect the digits). Twist, in repeater systems, can be caused by the user's transmitter.

The audio fed into the transmitter is pre-emphasized before it is applied to the limiter circuit. Pre-emphasis causes high frequency tones to have more amplitude than low frequency tones, so the high frequency tone of a DTMF digit can be severely clipped while the low frequency tone is not. The result is twist, and the solution is to keep the DTMF pad audio at a reasonably low level. The repeater receiver can also introduce twist if it has poor audio response, or if a poor impedance match exists between the receiver and the controller.

b. Command Sources

The DTMF decoder can monitor all receiver inputs and the phone line for incoming digits, but it can monitor only one device at a time. Therefore, a priority scheme is used to determine which source feeds the decoder at any given time. If no source is active, the decoder's input is grounded.

c. Local Control

You can program the controller with a local DTMF keyboard, if desired. Connect the audio from the keyboard to the Receiver #1 Audio Input, and connect a switch between the RX #1 COR input and ground. Whenever the switch is ON (closed), the controller will accept commands from the keyboard. Or, you can use the same scheme with Receiver #2 and leave the keyboard permanently connected. Return the switch to the OFF (open) position when finished programming, so that the repeater receiver (#1) can drive the DTMF decoder one again.

d. Testing

Generate an RF signal on the repeater's input frequency. While listening to the repeater output on an extra receiver, send some DTMF digits to the repeater. You should hear a short burst of DTMF, followed by silence, as the controller detects the digit and then mutes it.

If the digits are passed through to the transmitter with no muting taking place, then the DTMF decoder is not recognizing the digits. There are several areas to check:

1. Check the audio level at the output of the Receiver #1 audio op amp; it should be 700 mV rms (2 V p-p) as discussed in the installation section.
2. Check the operation of the Receiver #1 COR input. If the COR input isn't active, the DTMF decoder will not be monitoring the repeater receiver audio.
3. Check the other receiver COR input and associated dipswitch. If a higher-priority input is active, the DTMF decoder will be monitoring that input, not the repeater receiver.

4. Check to see if a command was entered to disable the DTMF decoder from the repeater receiver.

e. Falsing

Some user's voices can contain frequency components that appear as DTMF digits to the decoder. If such a digit is detected, "falsing" is said to occur. If the DTMF Muting feature is enabled, then the result of falsing is the loss of repeat audio for a syllable or two.

Also, an accidental digit is stored into the controller's command buffer. However, this last item is not usually a problem, as the digit will be discarded after a few seconds when the controller discovers that the digit was not part of a valid command.

In any case, falsing is annoying and can usually be cured to an acceptable extent. Several solutions are available:

1. TURN OFF THE DTMF MUTING FEATURE. If you do this, then all DTMF digits will be repeated. This is a simple fix, but it may not be acceptable for repeaters that need security on DTMF commands.
2. DON'T OVERDRIVE THE DTMF DECODER. The higher the audio level to the decoder, the more likely it is to false. Check the audio level at the output of the receiver's op amp; if over the recommended 700 mV rms (2 V p-p), turn it down. Overdriving the decoder does not help it decode any better.
3. INCREASE THE DTMF DECODER'S DETECT TIME. The decoder's tone detect time is controlled by resistor R7, which is 300K as shipped from the factory. This provides a rather fast 40 mS detect time (a telephone company standard). Increasing R7 will require a longer detect time, thus reducing the possibility of falsing.

The disadvantage of slowing the detection time is that some DTMF autodialers generate digits at a rapid rate; a long detection time could result in missed digits.

If autodialers are not a problem, then increasing the detection time will make a noticeable improvement in falsing. Field experience has shown that changing R7 to 500K will solve minor cases, and changing it to 1M solves nearly all cases. The slower response to DTMF digits has not been a problem for users, since the increase in time is small by human operator standards.

PROGRAMMING FUNDAMENTALS

1. INTRODUCTION

You program the controller by entering strings of DTMF digits. These strings of digits are referred to as commands. A standard DTMF keyboard with 12 digits may be used for nearly all commands. A few advanced features are available to programmers with 16-button keyboards. The extra four lettered keys may be used in passwords or macro names to increase the security of the system.

As shipped from the factory, the DTMF decoder requires about 40 mS to detect a valid digit. The microprocessor scans the decoder once every 10 mS to see if a digit has been detected. Thus, it can take about 50 mS to store a valid digit. Allowing a 50 mS pause between digits, the controller is able to store about 10 digits per second. Since these are best-case times, use longer durations and pauses if you wish to reliably program the controller with automatic DTMF sending equipment.

The controller may be programmed over any of the receiver inputs and the telephone line, if enabled. The controller responds to valid commands by sending acknowledgement messages. These responses may be disabled if desired.

In this section of the manual, we will discuss the basic structure of control commands.

2. CONTROL COMMAND STRUCTURE

All control commands follow the format described as follows:

1. A control command always begins with a **password**. The password increases the security of the system. It can be changed at any time. The password can be 2, 4 or 6 digits long, and may consist of any combination of the numbers 0 through 9, and the letters A, B, C and D. Star (*) and pound (#) are not allowed in passwords. The controller supports several passwords, used in programming the system and in accessing the autopatch.
2. Following the password is a **root number**. The root number tells the controller which function the owner wishes to program. Root numbers are either 2 or 4 digits long, and consist only of the numbers 0 through 9. Each control command has a unique root number. The root number is fixed by the controller's internal software and cannot be changed.
3. Following the root number may be one or more **data digits**. Some commands are quite simple, and do not need any data digits. Other commands will require a string of data digits.
4. Following the data digits (if any) is a **terminator**. The terminator can be either the star character (*) or a carrier drop (if enabled). The star character will always work as a terminator; in fact, it is necessary when programming the controller via the telephone, since there is no carrier to drop.

The terminator tells the controller that the command has ended. It is necessary, since control commands vary in length. The terminator is similar to a "carriage return" on a computer keyboard, or the "equals" key on a calculator.

Here's an example of a control command:

99 70 123 *

We've put spaces between some digits to help explain this example. You do not need any pauses between digits when you are programming the controller.

The **password** in this example is **99**, the default password. The password tells the controller that you are a legitimate programmer.

The **root number** is **70**. This root number tells the controller that you wish to turn on some logic outputs.

The **data digits** are **1, 2, 3**. In this particular command, the digits 1, 2, 3 tell the controller that you want to turn on logic outputs 1, 2, and 3.

The **terminator** is *****, which tells the controller that you have reached the end of this particular command. The controller always waits for the terminator before it processes a command.

If we have made no mistakes in entering this command, the controller will respond with a message and turn on the outputs. If a mistake were made in the command, such as asking for output 0 to turn on, then the controller would have sent an error message. None of the outputs would have changed. If you enter a control command with an incorrect password or a non-existent root number, the controller will not respond to the command.

3. RESPONSE MESSAGES

Most control commands respond in some way to tell you that they were accepted, or that you made a mistake in entering the command. The usual acknowledgement message is "OK" (sent in CW). If another response is more appropriate, then it will be sent instead of the "OK". There are two commonly-used error messages, sent as "? ERR 1" and "? ERR 2". They are defined as follows:

- "? ERR 1" means you have made an error in the number of keystrokes you entered for this particular command. If the command requires 5 keystrokes, for example, and you entered 6, then the response will be an error 1.
- "? ERR 2" means you have made an error in the data that was presented for this particular command. If a timer, for example, has a range of 0 to 5.0 seconds, and you enter 6.0 seconds, then the response will be an error 2.

Response messages can be turned on and off.

4. SPECIAL KEYS

There are two keys on your 12-button or 16-button DTMF keyboard that have special meanings to the controller. They are the star (*) and pound (#) symbols. (The "#" symbol is technically called an octothorpe . . . but we'll just call it a "pound"). These two characters are not allowed to be part of a password or macro name, and they won't be found in root numbers or data digits.

As mentioned earlier, the star (*) digit serves as a terminator, indicating to the controller that you have finished entering a command. The "*" will always work as a terminator. You can also allow a carrier drop to work as a terminator if you wish; the carrier drop method can be turned on and off, but the "*" method can't be turned off, and will terminate any command.

Why do we have the two methods? It's easier to terminate a command by simply releasing the PTT (push-to-talk) button on your microphone, and you have saved one keystroke (the "*"). However, there could be a weak carrier on the repeater's input frequency some day when you enter a command. If the carrier continues to hold up the repeater after you've released the PTT button, your command won't be executed. Entering the "*" at the end of the command will guarantee that the command is properly terminated.

A second reason for using the "*" terminator is that you may enter a series of commands, one after the other, without releasing the PTT button. (You do not have to wait for the acknowledgement message before entering the next command). You must, of course, use the "*" terminator when entering commands from a Touch-Tone (R) telephone, since there is no carrier drop for the controller to detect.

The pound (#) digit serves as a "clear" or "abort" key. It indicates to the controller that you have made an error, and you wish to clear the command buffer. (The command buffer is a holding area for the partially-entered command). The "#" key only works if the command is still in the buffer, and has not been executed. When you enter the terminator, the command is immediately executed and it is too late to clear the buffer. You may start entering the next command immediately after pressing the "#" key. There is no acknowledgement message sent by the controller when a command is cleared. Any digits following the "#" digit will be considered a new command.

5. DTMF INTERDIGIT TIMER

The controller uses a DTMF Interdigit Timer for the purpose of clearing the command buffer if a command is not completely entered. For example, if a user accidentally presses a digit, or if a digit is "falsed" into the buffer, or if a user drives out of range or his signal flutters while entering a command, then the command buffer will have only a piece of a command. If the controller had no time limit between digits, then that piece of a command would stay in the buffer. The controller would confuse it with the next command it receives.

The Interdigit Timer works as follows: When you release any DTMF key, the timer is started. If you do not enter another DTMF digit within the time limit, the controller will clear the command buffer. The Interdigit Timer initially defaults to 5.0 seconds, but it can be reprogrammed with a different value if desired.

6. DTMF MUTE DELAY

The controller has a DTMF Mute feature that prevents your DTMF commands from being repeated. This feature can be turned on and off.

Unless your controller has been fitted with the optional Audio Delay Module, there will be a short burst (40 to 50 mS) of DTMF that is repeated at the beginning of a digit. This short burst occurs because the controller requires some time to detect the DTMF digit and shut off the audio gate.

To reduce the number of bursts, the controller will continue to mute the audio for a while after you

have released the DTMF key. Thus, if you enter a string of digits rapidly, there will be only a single burst (caused by the beginning of the first digit). If you wait too long between digits, the muting will end. The next digit you enter will cause a short burst at the beginning. The Mute Delay Timer initially defaults to 0.5 seconds, but it can be reprogrammed with a different value if desired.

MESSAGES

1. INTRODUCTION

Your controller uses **messages** to communicate with both the users of your repeater and the programmers of the repeater controller. Messages may be composed of combinations of CW (Morse) characters, beeps, DTMF characters, and various paging formats. Most of the controller's messages are remotely programmable via DTMF commands.

2. MESSAGE ADJUSTMENT POTS

Three of the 6K's eight pots are associated with messages. The three pots are:

CW	(R77)	Adjusts the level of the CW generator. Adjusting R77 will affect the CW level going to the transmitter and the CW level going to the telephone line.
PAGE	(R78)	Adjusts the level of the page tone generator. Adjusting R78 will affect the level used for 1-tone, 2-tone, and 5/6-tone pages to the transmitter.
DTMF ENC	(R79)	Adjusts the level of the DTMF generator when sending DTMF pages to the transmitter. Does not adjust the level of DTMF digits when dialing the phone.

All pots adjust clockwise to increase level, and adjust counter-clockwise to decrease level.

CW level is typically set to a low level of deviation (500 Hz to 1.5 KHz). CW identifications must be recognizable, but they should not interfere with voice conversations.

Page levels are typically set to a high level of deviation (3.0 KHz to 3.3 KHz) so they can reliably trip pagers.

DTMF level should be set per the requirements of your DTMF receiving equipment. High levels should be avoided to minimize twist problems. Note that the level of DTMF characters sent to the phone line when dialing is not adjustable. This level is fixed in accordance with FCC Part 68 rules and regulations.

When sending tone pages, the controller can acknowledge by sending the page to the phone line. This level is the same as the CW level.

3. MESSAGE THEORY OF OPERATION

The controller uses a large area of memory, called the Message Buffer, to temporarily store the messages that it is asked to send. The Message Buffer is a "FIFO" buffer (First-In, First-Out), which means that the first message to arrive is the first one sent out. The purpose of the buffer is to prevent overruns when several software programs need to send messages simultaneously.

The various messages are loaded into the buffer by the programs that need to send their messages; the messages are unloaded by a program called the Message Handler. The Message Handler needs to know the type of message it is unloading, so that it can operate the proper hardware (DTMF encoder, tone encoder, etc.). The way we tell the Message Handler the type of message we desire is with special **Control Characters**.

4. MESSAGE CONTROL CHARACTERS

All Control Characters are four (4) digits long, and always begin with **99**. The **99** tells the Message Handler that special instructions follow. The next two digits contain those special instructions. The Control Characters that have been defined to date are:

CONTROL CHARACTER DEFINITIONS

- 9900** CW Characters follow
- 9910** Beep Characters follow
- 9920** A Single-Tone Page follows
- 9930** A Two-Tone Page follows
- 9940** A 5/6-Tone Page follows
- 9950** DTMF Characters follow

- 9981** Route the following message to the transmitter
- 9983** Route the following message to the phone line
- 9985** Unroute the following message to the transmitter
- 9987** Unroute the following message to the phone line

Any programmable message can contain any mixture of message types and routings described above. Therefore, a message could be made up of several different types of characters or tone pages, intended for different destinations.

When programming a message, first enter the routing, then the type of message, then the message itself.

Routing codes were developed to give the customer control over the routing of messages to the transmitter and phone line. You can use these codes to force IDs, courtesy beeps, timeout messages, and so on to go to the transmitter, even when a control operator is programming via the phone line.

When the message ends, the Message Handler defaults back to standard routing. Standard routing means that all messages normally go to the transmitter except when a control operator is programming the controller via the phone line, in which case all messages are sent to the phone line.

The following sections discuss each message type in greater detail.

5. CW MESSAGES

A. Control Character

The Control Character **9900** should be entered before the actual CW characters when building a CW message. If a message does not begin with a Control Character, the Message Handler will assume that the message should be sent in CW. Therefore, a CW-only message would not require the **9900**. However, a message could be made up of mixed types, such as a series of beeps followed by CW characters. In that case, the Control Character **9900** is needed before the CW portion of the message.

B. Format

Enter the Control Character **9900**. Then enter the various CW character codes described in the "CW Character Set" to create the desired message. You may end the CW message with the * character, or you may enter another Control Character (99xx) and continue with another message type.

C. Delay Character

A special pre-message delay character, **54**, can be programmed after the Control Character **9900** but before the CW characters. The **54** causes the Message handler to pause for 1 second before sending the CW message. Any additional **54**s found after the first one will be ignored. If the CW message was preceded by another message, the **54** will be ignored.

D. Wordspace

The wordspace character, **40**, should be placed between the words in a CW message.

The Message Handler will automatically place a wordspace at the end of a CW message, so you won't have to remember to do so. This feature prevents two adjacent CW messages from being run together.

Wordspace characters can be used as pauses during a CW message. However, the length of the pause will depend upon the current sending speed of the CW (words-per-minute).

E. Frequency Change

The CW frequency (pitch) may be changed before, or during a CW message. This feature allows you to draw attention to a certain message (or part of a message). A 6-digit character, **59xxxx**, should be entered ahead of the CW characters that which are to be sent at the new frequency. The four digits following the **59**, shown as **xxxx**, represent the new frequency and are taken from the Tone Code Table.

The frequency may be changed as often as desired within a CW message (even between each character).

At the end of a CW message, the Message Handler will change the frequency back to normal. This allows you to create a special CW message with a unique pitch, and not worry about changing the frequency back to normal to prevent affecting later messages.

If you wish to change the CW frequency for ALL CW messages, see the CW Frequency Control Command.

F. Speed Change

The CW sending speed in WPM (words per minute) may be changed before, or during a CW message. The speed may be varied from 5 to 40 WPM in ten steps. This feature allows you to draw attention to a certain CW message, or make it more easily copies by those with modest CW skills.

To temporarily change the sending speed of a CW message, enter a 2-digit character from **60** to **69** ahead of the CW characters that are to be sent at the new speed.

The speed may be changed as often as desired within a CW message (even between each character).

At the end of a CW message, the Message Handler will change the sending speed back to normal. This allows you to create a special CW message with a unique speed, and not worry about changing the speed back to normal to prevent affecting later messages.

If you wish to change the sending speed for ALL CW messages, see the CW Speed Select Control Command. If you wish to allow users to slow down CW messages, see the Send Next Message Slowly command.

G. Alphanumeric Characters

The controller features a library of 54 alphanumeric CW characters, consisting of the numerals 0 through 9, the letters A through Z, punctuation and standard Morse abbreviations. Each character is represented by a 2-digit code from **00** to **53**. When building a CW message, be sure to use both digits of the code (do not omit leading zeroes).

CW CHARACTER SET

CW Control Character = 9900

Char.	Code	Char.	Code	Char.	Code	Char.	Code
0	00	9	09	I	18	R	27
1	01	A	10	J	19	S	28
2	02	B	11	K	20	T	29
3	03	C	12	L	21	U	30
4	04	D	13	M	22	V	31
5	05	E	14	N	23	W	32
6	06	F	15	O	24	X	33
7	07	G	16	P	25	Y	34
8	08	H	17	Q	26	Z	35

Period .	36	End-of-Work SK	45
Comma ,	37	Hyphen -	46
Fraction /	38	Colon :	47
Question ?	39	Semicolon ;	48
Space	40	Parenthesis ()	49
End-of-Msg AR	41	Apostrophe '	50
Wait AS	42	Exclamation !	51
Break BK	43	Quotation "	52
Double Dash BT	44	Understood	53

1.0-Second Pre-Message Delay	54
Frequency Change	59xxxx

SPEED CHANGE

WPM	Code	WPM	Code
5	60	17	65
7	61	20	66
10	62	24	67
13	63	30	68
15	64	40	69

6. BEEP MESSAGES

A. Control Character

The Control Character **9910** must be entered before the actual beep characters when building a beep message. Remember, any message that does not have a control character will be interpreted as a CW message!

B. Format

Enter the Control Character **9910**. Then enter the various beep character codes described in the Beep Character Set to create the desired message. You may end the beep message with the * character, or you may enter another Control Character (99xx) and continue with another message type.

C. Delay Character

A special pre-message delay character, **54**, can be programmed after the Control Character **9910** but before the beep characters. The **54** causes the Message handler to pause for 1 second before sending the CW message. Any additional **54s** found after the first one will be ignored. If the beep message was preceded by any other message, the **54** will be ignored.

D. Factory-Fixed-Frequency Beeps

Forty-eight (48) beeps have been defined in frequency but have variable duration. These beeps are programmed with the character codes **00** through **47** and cover almost four octaves from 262Hz to 3951Hz. It is best to avoid beeps below 300Hz and above 3000Hz, since most radio systems are designed for 300-3000Hz response.

E. Owner-Fixed-Frequency Beeps

Six (6) beeps are definable in frequency by the owner, and have variable duration. They default to factory-selected frequencies upon a cold start. The frequencies may be changed, and the new frequencies will be retained upon a warm start. These beeps are programmed with the character codes **48** through **53**.

F. Custom Beeps

Custom Beeps are defined "on-the-fly" in both frequency and duration. An 8-digit character, **57xxxxyy**, defines the Custom Beep. The four digits following the **57**, shown as **xxxx**, represent the frequency and are taken from the Tone Code Table. The next two digits, shown as **yy**, represent the duration in tens of milliseconds.

Custom beeps allow you to create a unique message with any frequency and any duration to 990mS. As an example, let's define a custom beep of 1275Hz for 70mS. The custom beep code would be **57078407**.

G. Custom Delay

Custom Delays are defined "on-the-fly" in duration. A 4-digit character, **58xx**, defines the custom delay. The two digits following the **58**, shown as **xx**, represent the duration of the delay in tens of milliseconds.

Although custom delays can be placed anywhere in a beep message, they go well with custom beeps if you need to create a truly unique or specialized signaling burst. For example, a string of custom beeps and custom delays could be used to generate a string of ASCII characters of the proper tones for use with modems.

H. Gap Characters

Gap Characters are used to introduce a silent period between beeps. Ten (10) gap characters have been defined from 10mS to 320mS using the codes **60** through **69**. Gap characters may be used alone to separate groups of beeps, or they can be automatically placed after every beep by using the **Automatic Gap On** code (described later). Note that any time a gap character is entered, the Message Handler remembers its duration. When the **Automatic Gap On** character is encountered, the Message Handler will use the duration that it remembered from the previous gap character. This is also true of the Custom Delay character. This parameter is not changed at the end of the beep message.

I. Beep Duration Change

Beep Duration Change characters are used to set the duration of the beep characters that follow. Ten (10) duration change characters have been defined from 10mS to 320mS using the codes **70** through **79**. The beep duration may be changed as often as desired within a beep message (even between each beep).

Note that any time a beep duration change is made (including a Custom Beep), the duration will be remembered by the Message Handler. When any succeeding beep is encountered, the Message Handler will use the duration that it remembered from the previous duration change.

This parameter is not changed at the end of the beep message.

J. Automatic Gap On

The Automatic Gap On character, **56**, causes the Message Handler to place a gap between each beep. The duration of the gap depends on that last gap that was encountered. It defaults to 10mS upon a cold start.

K. Automatic Gap Off

The Automatic Gap Off character, **55**, causes the Message Handler to send the beeps that follow in a series without any gaps between them.

L. Defaults

Upon a cold start, the following defaults will be forced:

Beep Duration	60mS
Gap Duration	10mS
Automatic Gap	OFF

BEEP CHARACTER SET

Beep Control Character = 9910

FACTORY FIXED-FREQUENCY BEEPS

Code	Hz	Note	Code	Hz	Note	Code	Hz	Note
00	262	C3	16	659	E4	32	1661	G#5
01	277	C#3	17	698	F4	33	1760	A5
02	294	D3	18	740	F#4	34	1865	A#5
03	311	D#3	19	784	G4	35	1976	B5
04	330	E3	20	831	G#4	36	2093	C6
05	349	F3	21	880	A4	37	2217	C#6
06	370	F#3	22	932	A#4	38	2349	D6
07	392	G3	23	988	B4	39	2489	D#6
08	415	G#3	24	1046	C5	40	2637	E6
09	440	A3	25	1109	C#5	41	2794	F6
10	466	A#3	26	1175	D5	42	2960	F#6
11	494	B3	27	1244	D#5	43	3136	G6
12	523	C4	28	1319	E5	44	3322	G#6
13	554	C#4	29	1397	F5	45	3520	A6
14	587	D4	30	1480	F#5	46	3729	A#6
15	622	D#4	31	1568	G5	47	3951	B6

OWNER-PROGRAMMED, FIXED-FREQUENCY BEEPS

Code	Owner-Programmed Freq (Hz) (owner fills in)	Default Freq (Hz)
48		500
49		750
50		1000
51		1250
52		1500
53		1750

GAP CHARACTERS & BEEP DURATION CHANGE CHARACTERS

Code	Gap (mS)	Code	Duration change (mS)
60	10	70	10
61	20	71	20
62	30	72	30
63	40	73	40
64	60	74	60
65	80	75	80
66	120	76	120
67	160	77	160
68	240	78	240
69	320	79	320

MISCELLANEOUS

1 Sec. Pre-Msg Delay	54	Custom Beep	57xxxxyy
Automatic Gap Off	55	Custom Delay	58xx
Automatic Gap On	56		

7. SINGLE-TONE PAGE

A. Control Character

The Control Character **9920** must be entered before the actual page code when building a single-tone page message. If several single-tone pages are to be sent, then the control character **9920** must exist before each page code.

B. Format

Enter the Control Character, **9920**. Then enter four digits representing the frequency of the page tone, taken from the Tone Code Table. Then enter two digits representing the duration of the page tone in tenths of seconds. The range of duration is 0.1 to 9.9 seconds. You may end the message with the * character, or you may enter another Control Character (99xx) and continue with another message type.

For example, the format of a single-tone page of 1050Hz for 8.0 seconds (National Weather Service standard page) is **9920 0952 80**.

C. Delays

A 1-second pre-page delay is created by the Message Handler for the first page in a group. If additional pages follow, the pre-page delay is eliminated in succeeding pages.

A 3-second post-page delay is created by the Message Handler for all single-tone pages.

8. TWO-TONE SEQUENTIAL PAGE

A. Control Character

The Control Character **9930** must be entered before the actual page code when building a two-tone sequential page message. If several two-tone pages are to be sent, the control character **9930** must exist before each two-tone page code.

B. Format

Enter the Control Character, **9930**. Then enter four digits representing the frequency of the first tone, taken from the Tone code Table. Then enter two digits representing the duration of the first tone in tenths of seconds. The range of duration is 0.1 to 9.9 seconds. Then enter four digits representing the frequency of the second tone, taken from the Tone Code Table. Then enter two digits representing the duration of the second tone in tenths of seconds. The range of duration is 0.1 to 9.9 seconds. You may end the message with the * character, or you may enter another Control Character (99xx) and continue with another message type.

For example, the format of a two-tone sequential page of 349.0Hz for 1.0 seconds followed by 433.7Hz for 3.0 seconds is **9930 2865 10 2306 30**.

C. Delays

A 1-second pre-page delay is created by the Message Handler for the first page in a group. If additional pages follow, the pre-page delay is eliminated in succeeding pages.

A 1.3-second post-page delay is created by the Message Handler for all two-tone sequential pages.

9. FIVE/SIX-TONE PAGE

A. Control Character

The Control Character **9940** must be entered before the actual page code when building a 5/6-tone page message. If several 5/6-tone pages are to be sent, the control character **9940** must exist before each 5/6-tone page code.

B. Format

Enter the Control Character, **9940**. Then enter the Preamble Digit (0 - 9), followed by the five digits (0 - 9), followed by a 1 if you wish to send the X ("dual-address") tone or a 0 if you do not wish to send the X tone. You may end the message with the * character. If you wish to enter another Control Character (99xx) and continue with another message type, then you must add another digit to the end of the 5/6-tone page. This is required because the normal format results in an odd number of characters (11), and the Message Handler expects messages to have even numbers of characters.

For example, the format of the 5/6-tone page "1-13657X" is **9940 1136571**. If no "X" tone is desired, the format is **9940 1136570**. To send a second page in the same message, a "bogus" digit would be added at the end of the first page to restore evenness to the command. The format would be **9940 1136571 0 9940 1136571**. Note that we added a bogus zero digit to force the second page to begin on an even digit count.

The Message Handler always required a preamble digit. It will automatically substitute the "R" tone for a repeated digit.

C. Delays

A 1-second pre-page delay is created by the Message Handler for the first page in a group. If additional pages follow, the pre-page delay is eliminated in succeeding pages.

A 1-second post-page delay is created by the Message Handler for all 5/6-tone pages.

10. DTMF PAGE

A. Control Character

The Control Character **9950** should be entered before the actual DTMF character codes when building a DTMF Page message. If a message does not begin with a Control Character, the Message Handler will assume that the message should be sent in CW!

B. Format

Enter the Control Character **9950**. Then enter the various DTMF character codes described in the "DTMF Character Set" to create the desired message/page. You may end the DTMF message with the * character, or you may enter another Control Character (99xx) and continue with another message type.

C. Delays

A 1-second pre-page delay is created by the Message Handler for the first page in a group. If additional pages follow, the pre-page delay is eliminated in succeeding pages.

A 1-second post-page delay is created by the Message Handler for all DTMF pages.

If desired, a DTMF page can consist of several DTMF digits, a pause, more DTMF digits, another pause, and so on. This feature allows you to place a series of DTMF pages within one message.

D. DTMF Characters

There are 16 DTMF characters: Numerals 0 through 9, letters A through D, and the symbols "*" and "#". Each character has a two-digit code, shown on the DTMF Character Set chart. Enter the appropriate two-digit code for each DTMF character that you wish to send.

E. Duration Change

You may wish to change the duration of the DTMF characters from the default duration of 100 mS. Ten of the most common durations are shown on the DTMF Character Set chart. If you wish to change the duration to one of the values shown, enter the two-digit code corresponding to your choice. If the duration you want is not on the chart, then go to the "Custom Duration Change" description below. Once you change the duration, it will stay at the new value indefinitely, or until changed again by another code.

F. Custom Duration Change

The easiest way to change the duration of the DTMF characters is to use the 2-digit codes mentioned in part (E) above. However, you may require other durations, so the controller allows you to choose a custom duration. Duration may be set from 10 mS to 9900 mS (0.01 to 9.9 seconds). Use the code "50xx" where "xx" is a number from 01 to 99 to get durations from 10 mS to 990 mS. Use the code "51xx" where xx is a number from 01 to 99 to get durations from 100 mS to 9900 mS. Once you change the duration, it will stay at the new

value indefinitely, or until changed again by another code.

G. Gap Change

Every DTMF character sent by the controller is followed by a "gap", or silent period. You may wish to change the duration of this gap from the default value of 100 mS. Ten of the most common gap durations are shown on the DTMF Character Set chart. If you wish to change the gap to one of the values shown, enter the two-digit code corresponding to your choice. If the gap you want is not on the chart, then go to the "Custom Gap Change" description below. Once you change the gap duration, it will stay at the new value indefinitely, or until changed again by another code.

H. Custom Gap Change

The easiest way to change the duration of the gap is to use the 2-digit codes mentioned in part (G) above. However, you may require other gap durations, so the controller allows you to choose a custom gap duration. Duration may be set from 10 mS to 9900 mS (0.01 to 9.9 seconds). Use the code "52xx," where "xx" is a number from 01 to 99, to get gaps from 10 mS to 990 mS. Use the code "53xx" where "xx" is a number from 01 to 99, to get gaps from 100 mS to 9900 mS. Once you change the gap duration, it will stay at the new value indefinitely, or until changed again by another code.

NOTE: If you intend to program a large number of DTMF pages with varying tone durations and gap durations, it would be a good idea to set up the proper duration values at the beginning of each individual page. Otherwise, the old values from the previous page will be used for the new page.

I. Pause

Unlike a "gap", which is automatically sent after each DTMF character, a "pause" may be inserted anywhere in a DTMF page. Pauses are typically used to separate individual pages within a multi-page message.

Ten common pause durations are shown on the DTMF Character Set chart. If you wish to insert a pause into a page, enter the two-digit code corresponding to your choice. If the pause you want is not on the chart, then go to the "Custom Pause" description below.

J. Custom Pause

The easiest way to insert a pause is to use the 2-digit codes mentioned in part (I) above. However, you may require other pauses, so the controller allows you to choose a custom pause. Duration may be set from 10 mS to 9900 mS (0.01 to 9.9 seconds). Use the code "54xx", where "xx" is a number from 01 to 99, to get pauses from 10 mS to 990 mS. Use the code "55xx", where "xx" is a number from 01 to 99, to get pauses from 100 mS to 9900 mS.

NOTE: Since each DTMF character is followed by a gap, be sure to add the gap duration to the pause duration if you want an accurate idea of the time between two DTMF pages.

NOTE: Pauses are "additive": A long pause may be created by placing a series of pauses together within a DTMF page.

K. Defaults

Until changed by the codes mentioned, the DTMF tone duration is 100 mS, and the gap between DTMF characters is 100 mS.

L. Other Notes

The DTMF decoder is turned off during DTMF pages to prevent the page from being acted on by the controller.

Since the DTMF encoder is shared between the DTMF paging function and the DTMF autopatch dialing function, there may be a delay in paying while a number is dialed (or vice versa).

DTMF CHARACTER SET

Control Character = 9950

DTMF Character	Code	Duration Change (mS)	Code	Gap Change (mS)	Code	Pause (mS)	Code
0	00	30	20	20	30	100	40
1	01	40	21	30	31	200	41
2	02	50	22	40	32	300	42
3	03	60	23	50	33	400	43
4	04	70	24	60	34	500	44
5	05	80	25	70	35	600	45
6	06	90	26	80	36	700	46
7	07	100	27	90	37	800	47
8	08	150	28	100	38	900	48
9	09	200	29	150	39	1000	49
A	10						
B	11						
C	12						
D	13						
*	14						
#	15						

Custom Duration Change	50xx, xx = 01-99 x 10 mS
	51xx, xx = 01-99 x 100 mS
Custom Gap Change	52xx, xx = 01-99 x 10 mS
	53xx, xx = 01-99 x 100 mS
Custom Pause	54xx, xx = 01-99 x 10 ms
	55xx, xx = 01-99 x 100 ms

NOTE: For all custom codes, if 00 is entered for "xx", the custom code will be ignored.

Examples:

- (1) To generate a DTMF page of "1, 2, 3, A, B, C" at the default durations, enter:

(PW) 15 9950 01 02 03 10 11 12 *

- (2) To generate the same page but with 50 mS tones and 40 mS gaps, enter:

(PW) 15 9950 22 32 01 02 03 10 11 12 *

- (3) To generate a second page within the same message of "4, 5, 6" one second later, enter:

(PW) 15 9950 22 32 01 02 03 10 11 12 49 04 05 06 *

TONE CODES

When entering tone frequencies for CW, beep, or paging messages, a **tone code** is required. A tone code is a 4-digit number that may be either taken from the Tone Code Table or calculated.

The Tone Code Table was created to simplify your programming efforts by listing frequencies from 100Hz to 3KHz (in 5Hz increments), and the appropriate tone code for each frequency. (Note that most radio systems have a response of 300Hz to 3KHz, and will not pass tone frequencies outside of this range).

If you wish to program a tone frequency that is not listed in the Tone Code Table, you will need to calculate its tone code. (This is particularly true of paging tones, which are specified to tenths of Hertz). To assist you in calculating your tone codes, the following explanation is offered.

Tone codes are actually 4-digit numbers representing the period of the tone sine wave in microseconds. To determine your tone code, simply take the reciprocal of the tone frequency. It is easily done on a calculator: Enter 1,000,000, and then divide this number by the tone frequency in Hertz. The quotient, rounded off to a 4-digit whole number, is the tone code. If the result is 999 or less, you must insert a leading zero. Here are some examples:

Example 1: The tone frequency is 1200Hz. What is the tone code?

Dividing 1,000,000 by 1200 yields **833.3**, so the tone code is **0833**.

Example 2: The tone frequency is 398.1Hz. What is the tone code?

Dividing 1,000,000 by 398.1 yields 2511.9, so the tone code is **2512**.

TONE CODE TABLE

Freq	Code								
100	9999	300	3333	500	2000	700	1429	900	1111
105	9524	305	3279	505	1980	705	1418	905	1105
110	9091	310	3226	510	1961	710	1408	910	1099
115	8696	315	3175	515	1942	715	1399	915	1093
120	8333	320	3125	520	1923	720	1389	920	1087
125	8000	325	3077	525	1905	725	1379	925	1081
130	7692	330	3030	530	1887	730	1370	930	1075
135	7407	335	2985	535	1869	735	1361	935	1070
140	7143	340	2941	540	1852	740	1351	940	1064
145	6897	345	2899	545	1835	745	1342	945	1058
150	6667	350	2857	550	1818	750	1333	950	1053
155	6452	355	2817	555	1802	755	1325	955	1047
160	6250	360	2778	560	1786	760	1316	960	1042
165	6061	365	2740	565	1770	765	1307	965	1036
170	5882	370	2703	570	1754	770	1299	970	1031
175	5714	375	2667	575	1739	775	1290	975	1026
180	5556	380	2632	580	1724	780	1282	980	1020
185	5405	385	2597	585	1709	785	1274	985	1015
190	5263	390	2564	590	1695	790	1266	990	1010
195	5128	395	2532	595	1681	795	1258	995	1005
200	5000	400	2500	600	1667	800	1250	1000	1000
205	4878	405	2469	605	1653	805	1242	1005	0995
210	4762	410	2439	610	1639	810	1235	1010	0990
215	4651	415	2410	615	1626	815	1227	1015	0985
220	4545	420	2381	620	1613	820	1220	1020	0980
225	4444	425	2353	625	1600	825	1212	1025	0976
230	4348	430	2326	630	1587	830	1205	1030	0971
235	4255	435	2299	635	1575	835	1198	1035	0966
240	4167	440	2273	640	1563	840	1190	1040	0962
245	4082	445	2247	645	1550	845	1183	1045	0957
250	4000	450	2222	650	1538	850	1176	1050	0952
255	3922	455	2198	655	1527	855	1170	1055	0948
260	3846	460	2174	660	1515	860	1163	1060	0943
265	3774	465	2151	665	1504	865	1156	1065	0939
270	3704	470	2128	670	1493	870	1149	1070	0935
275	3636	475	2105	675	1481	875	1143	1075	0930
280	3571	480	2083	680	1471	880	1136	1080	0926
285	3509	485	2062	685	1460	885	1130	1085	0922
290	3448	490	2041	690	1449	890	1124	1090	0917
295	3390	495	2020	695	1439	895	1117	1095	0913

TONE CODE TABLE

Freq	Code								
1100	0909	1300	0769	1500	0667	1700	0588	1900	0526
1105	0905	1305	0766	1505	0664	1705	0587	1905	0525
1110	0901	1310	0763	1510	0662	1710	0585	1910	0524
1115	0897	1315	0760	1515	0660	1715	0583	1915	0522
1120	0893	1320	0758	1520	0658	1720	0581	1920	0521
1125	0889	1325	0755	1525	0656	1725	0580	1925	0519
1130	0885	1330	0752	1530	0654	1730	0578	1930	0518
1135	0881	1335	0749	1535	0651	1735	0576	1935	0517
1140	0877	1340	0746	1540	0649	1740	0575	1940	0515
1145	0873	1345	0743	1545	0647	1745	0573	1945	0514
1150	0870	1350	0741	1550	0645	1750	0571	1950	0513
1155	0866	1355	0738	1555	0643	1755	0570	1955	0512
1160	0862	1360	0735	1560	0641	1760	0568	1960	0510
1165	0858	1365	0733	1565	0639	1765	0567	1965	0509
1170	0855	1370	0730	1570	0637	1770	0565	1970	0508
1175	0851	1375	0727	1575	0635	1775	0563	1975	0506
1180	0847	1380	0725	1580	0633	1780	0562	1980	0505
1185	0844	1385	0722	1585	0631	1785	0560	1985	0504
1190	0840	1390	0719	1590	0629	1790	0559	1990	0503
1195	0837	1395	0717	1595	0627	1795	0557	1995	0501
1200	0833	1400	0714	1600	0625	1800	0556	2000	0500
1205	0830	1405	0712	1605	0623	1805	0554	2005	0499
1210	0826	1410	0709	1610	0621	1810	0552	2010	0498
1215	0823	1415	0707	1615	0619	1815	0551	2015	0496
1220	0820	1420	0704	1620	0617	1820	0549	2020	0495
1225	0816	1425	0702	1625	0615	1825	0548	2025	0494
1230	0813	1430	0699	1630	0613	1830	0546	2030	0493
1235	0810	1435	0697	1635	0612	1835	0545	2035	0491
1240	0806	1440	0694	1640	0610	1840	0543	2040	0490
1245	0803	1445	0692	1645	0608	1845	0542	2045	0489
1250	0800	1450	0690	1650	0606	1850	0541	2050	0488
1255	0797	1455	0687	1655	0604	1855	0539	2055	0487
1260	0794	1460	0685	1660	0602	1860	0538	2060	0485
1265	0791	1465	0683	1665	0601	1865	0536	2065	0484
1270	0787	1470	0680	1670	0599	1870	0535	2070	0483
1275	0784	1475	0678	1675	0597	1875	0533	2075	0482
1280	0781	1480	0676	1680	0595	1880	0532	2080	0481
1285	0778	1485	0673	1685	0593	1885	0531	2085	0480
1290	0775	1490	0671	1690	0592	1890	0529	2090	0478
1295	0772	1495	0669	1695	0590	1895	0528	2095	0477

TONE CODE TABLE

Freq	Code								
2100	0476	2300	0435	2500	0400	2700	0370	2900	0345
2105	0475	2305	0434	2505	0399	2705	0370	2905	0344
2110	0474	2310	0433	2510	0398	2710	0369	2910	0344
2115	0473	2315	0432	2515	0398	2715	0368	2915	0343
2120	0472	2320	0431	2520	0397	2720	0368	2920	0342
2125	0471	2325	0430	2525	0396	2725	0367	2925	0342
2130	0469	2330	0429	2530	0395	2730	0366	2930	0341
2135	0468	2335	0428	2535	0394	2735	0366	2935	0341
2140	0467	2340	0427	2540	0394	2740	0365	2940	0340
2145	0466	2345	0426	2545	0393	2745	0364	2945	0340
2150	0465	2350	0426	2550	0392	2750	0364	2950	0339
2155	0464	2355	0425	2555	0391	2755	0363	2955	0338
2160	0463	2260	0420	2560	0391	2760	0362	2960	0338
2165	0462	2365	0423	2565	0390	2765	0362	2965	0337
2170	0461	2370	0422	2570	0389	2770	0361	2970	0337
2175	0460	2375	0421	2575	0388	2775	0360	2975	0336
2180	0459	2380	0420	2580	0388	2780	0360	2980	0336
2185	0458	2385	0419	2585	0387	2785	0359	2985	0335
2190	0457	2390	0418	2590	0386	2790	0358	2990	0334
2195	0456	2395	0418	2595	0385	2795	0358	2995	0334
2200	0455	2400	0417	2600	0385	2800	0357	3000	0333
2205	0454	2405	0416	2605	0384	2805	0357		
2210	0452	2410	0415	2610	0383	2810	0356		
2215	0451	2415	0414	2615	0382	2815	0355		
2220	0450	2420	0413	2620	0382	2820	0355		
2225	0449	2425	0412	2625	0381	2825	0354		
2230	0448	2430	0412	2630	0380	2830	0353		
2235	0447	2435	0411	2635	0380	2835	0353		
2240	0446	2440	0410	2640	0379	2840	0352		
2245	0445	2445	0409	2645	0378	2845	0351		
2250	0444	2450	0408	2650	0377	2850	0351		
2255	0443	2455	0407	2655	0377	2855	0350		
2260	0442	2460	0407	2660	0376	2860	0350		
2265	0442	2465	0406	2665	0375	2865	0349		
2270	0441	2470	0405	2670	0375	2870	0348		
2275	0440	2475	0404	2675	0374	2875	0348		
2280	0439	2480	0403	2680	0373	2880	0347		
2285	0438	2485	0402	2685	0372	2885	0347		
2290	0437	2490	0402	2690	0372	2890	0346		
2295	0436	2495	0401	2695	0371	2895	0345		

MESSAGE COMMANDS

FREQUENCY SELECT

Command Form:	Frequency of CW Frequency of Beep 48 Frequency of Beep 49 Frequency of Beep 50 Frequency of Beep 51 Frequency of Beep 52 Frequency of Beep 53	(PW) 06 00 (tonecode) * (PW) 06 01 (tonecode) * (PW) 06 02 (tonecode) * (PW) 06 03 (tonecode) * (PW) 06 04 (tonecode) * (PW) 06 05 (tonecode) * (PW) 06 06 (tonecode) *
Description:	This series of commands is used to change the frequency (pitch) of the CW and the six owner-fixed frequency beeps. Enter the password, followed by the 4-digit root number shown, followed by the 4-digit tone code for your desired frequency. The tone code is taken from the Tone code Table. Do not omit any leading zeroes. The frequency range is 100Hz to 5KHz, although most radio systems have an audio response of 300Hz to 3KHz.	
Acknowledgement:	OK	
Errors:	? ERR 1 wrong number of digits entered ? ERR 2 illegal code entered	
Default Conditions:	CW Frequency 1500 Hz Beep 48 Frequency 500 Hz Beep 50 Frequency 1000 Hz Beep 51 Frequency 1250 Hz Beep 52 Frequency 1500 Hz Beep 53 Frequency 1750 Hz	
Examples:	Let's change the frequency of the CW to 1200 Hz. The tone code for 1200 Hz is 0833. The command is: (PW) 06 00 0833 *	
	Let's now change the frequency of Beep 48 to 600 Hz. The tone code for 600 Hz is 1667. The command is: (PW) 06 01 1667 *	

MESSAGE COMMANDS

PROGRAMMABLE MESSAGES

Command Form:	Courtesy Message Dropout Message Pre-Timeout Message Post-Timeout Message Initial ID Message Normal ID Message Impolite ID Message Autopatch Dialing Message Autopatch Timeout Warning Message Reverse Patch Ringout Message	(PW) 31 10 (msg) * (PW) 31 13 (msg) * (PW) 31 16 (msg) * (PW) 31 19 (msg) * (PW) 31 30 (msg) * (PW) 31 31 (msg) * (PW) 31 32 (msg) * (PW) 31 40 (msg) * (PW) 31 41 (msg) * (PW) 31 51 (msg) *
Description:	This series of commands is used to change the various messages sent by the controller. Enter the password, followed by the 4-digit root number shown, followed by the desired message. Any message may have any combination of message types, including CW, beeps, page tones, etc. The maximum size of any message is 50 bytes (50 2-digit codes). You must count the Control Character. Therefore, any message could have 46 CW characters max, etc. To delete a message, enter the password, the 4-digit root number, and the "*" (do not enter any message).	
Acknowledgement:	OK	
Errors:	? ERR 1 too many digits entered ? ERR 2 illegal digit entered	
Default Conditions:	Courtesy Message Dropout Message Pre-Timeout Message Post-Timeout Message Initial ID Message Normal ID Message Autopatch Dialing Message Autopatch Timeout Warning Message Landline Answer Message Reverse Patch Ringout Message	60 mS, 440 Hz beep (74 09) (none) TO TO ID ID AS ("wait") AR ("end-of-msg") 3 beeps (74 09 21 33) 55 (CW)
Examples:	Let's change the Normal ID Message to "W0XYZ/R" in CW. It is a good idea to preface any CW message with the CW Control Character, 9900. Now, looking up "W0XYZ/R" in the CW Character Set table, we find 32 00 33 34 35 38 27. The entire command to change the Normal ID Message looks like this:	(PW) 31 31 9900 32 00 33 34 35 38 27 *

(The spaces are used to illustrate how the command works. The command

may be entered in a continuous string of digits).

Let's program a longer callsign into the Initial ID Message, using "DE W9XYZ/R CGO" (Chicago) in CW as the message. The command looks like this:

```
(PW) 31 30 9900 13 14 40 32 09 33 34 35 38 27 40 12 16 24 *
```

Note that we have used the wordspace character, 40, twice. This separates the "DE" from the "W9XYZ/R", and separates the "W9XYZ/R" from the "CGO".

Let's now change the Courtesy Message to a burst of 2 beeps. We want the two beeps to be 25 and 21, we want them each to be 40mS in duration, and we want no gap between them. Looking up this information in the Beep Character Set table, we find the **55** turns the gap off, and **73** sets the duration to 40mS. The Control Character for a beep message is **9910**. Therefore, the complete command to change the Courtesy Message looks like this:

```
(PW) 31 10 9910 55 74 25 21 *
```

MESSAGE COMMANDS

REVIEW MESSAGE

Command Form:	Courtesy Message Dropout Message Pre-Timeout Message Post-Timeout Message Initial ID Message Normal ID Message Autopatch Dialing Message Autopatch Timeout Warning Message Landline Answer Message Reverse Patch Ringout Message	(PW) 34 10 * (PW) 34 13 * (PW) 34 16 * (PW) 34 19 * (PW) 34 30 * (PW) 34 31 * (PW) 34 40 * (PW) 34 41 * (PW) 34 50 * (PW) 34 51 *
Description:	This series of commands is used to play back (review) the various messages that have been programmed into the controller. Enter the password, followed by the 4-digit root number shown. The controller will send the appropriate message for your examination. If you wish to change the message, see the "Programmable Messages" command.	
Acknowledgement:	Sends the appropriate message	
Errors:	? ERR 1 wrong number of digits entered ? ERR 2 illegal digit entered	

MESSAGE COMMANDS

SEND A MESSAGE

Command Form: (PASSWORD) 15 (message) *

Description: This command is used to send a message, but unlike the "Programmable Messages," this command does not store the message in memory. It has two purposes: (1) You can experiment with different message types by entering this command and listening for the results; and (2), You can place this command into a Macro so that a message is sent when the Macro is executed.

Acknowledgement: Sends the message

Errors: ? ERR 1 too many digits entered

Examples: Let's send some CW characters, some beep characters, then some CW characters again. The CW characters will be A, B, and C; the beeps will be 25 through 30 at 80 mS durations with 20 mS gaps between them; and the final CW characters will be 1, 2, and 3 at 30 WPM and 1000 Hz frequency.

Looking up the CW Character Set, we see that the Control Character is **9900**; A, B, and C are **10 11 12**. Looking up the Beep Character Set, we see that the Control Character is **9910**; to get 80 mS durations, we must enter **75**; to get 20 mS gaps we must enter **56** to turn the gaps on, and **61** to get 20 mS gaps. Going back to the CW Character Set once again, we see that the Control Character is **9900** again; to get 30 WPM we must enter **68**; to get 1000 Hz frequency, we must enter **591000**; and 1, 2, 3 is **01 02 03**.

Therefore, the complete command to send this message is:

(PW) 1599001011129910755661252627282930990068591000010203 *

You may never have a need for a message like this, but this example shows the flexibility available in the controller.

AUTOPATCH

INTRODUCTION

This section of the manual describes the Autopatch features in your controller. We use the term **Autopatch** to describe a telephone call originated by the repeater user. **Reverse Patch** calls, originated by a telephone user, are described elsewhere in this manual under the heading **Landline Control**.

The autopatch can be accessed in several ways:

- (1) You can manually enter the required DTMF digits via your radio's DTMF keyboard. You can program the controller to require an autopatch password ahead of the telephone number, or you can program the controller to only require the telephone number.
- (2) You can manually enter a macro name via your radio's DTMF keyboard. This previously-programmed macro would contain the autopatch password and telephone number as described above. The macro feature requires far fewer digits to be entered to dial the autopatch, but you must store the numbers you wish to dial into macros before you can use the macros.
- (3) You can program the COR Pulse Triggered Macro feature to execute one of the macros mentioned in (2). Then, a user would only need to key his microphone PTT button several times to access the autopatch and dial an emergency number. Only one number can be dialed this way. Likewise, any of the event-triggered macros can be used to dial the autopatch by creating an **autodial** type of macro, then loading that macro name into the proper event command.

The autopatch dialer software uses **store-and-forward** operation. This means that the controller takes no action until the entire telephone number has been entered. It then checks the number to see if it is acceptable. If acceptable, the number is dialed using pulse (rotary) format or regenerated DTMF format. This method is superior to the older **star (*) up** patch, in which phone line access is granted with just a DTMF **. The advantages of store-and-forward operation are:

1. There is never a prolonged dial tone that results from a user entering the **, then not placing a call.
2. Since the controller regenerates all DTMF digits going to the telephone line, noisy or inaccurate tones from the receiver cannot cause misdials.
3. The controller is never stuck in a mode where it must wait for a specific command type to be entered before it can continue operation.

In the store-and-forward scheme, every autopatch access command is completely self-contained. Therefore, any other command can be entered before or after an autopatch access command. Other commands that you might want to use during an autopatch include Dump, Re-dial, Timer Reset, or even a new access command. (Entering a new access command while already in an autopatch will cause the original call to be dumped and the new call to be dialed).

AUTOPATCH

The autopatch can be dumped in three ways:

1. You can enter the Autopatch Dump control code. This is not recommended, since the control code contains a programming password that should be kept secure.
2. You can enter the name of a macro you've programmed that contains the Autopatch Dump control code. This is a recommended method.
3. You can enter the "#" digit. This method only works if you wish to have a simple, one-character dump code that has little security. The **Pound (#) Down Dump** feature is switchable on or off.

Your controller has a large number of features that allow you to customize the operation of the autopatch. This discussion is simply an overview of autopatch operation. The following pages will discuss these features in detail.

AUTOPATCH

ACCESS (with password)

Command Form: (autopatch access password)(phone number)*

Description: To access the autopatch with the Autopatch Access Password, enter the Autopatch Access Password followed by the telephone number you wish to dial (and the "*", if required). All digits are entered in a continuous string. Entering only the autopatch Access Password will not result in a dial tone. The phone number may be up to 35 digits in length, and may contain special command digits (A, B, C, D).

Acknowledgement: Sends the **Dialing Message**

Errors:	OFF	Autopatch if Off
	? REJ	Rejected (Number was found in Reject Table)
	? ERR	Rejected (Number not allowed by Call Type)
	BZ	Landline Busy

Default Condition: The Autopatch Access Password defaults to **10**.

Examples: Assume that the Autopatch Access Password is 10, and that the number you wish to call is 456-7890. Enter the following:

10 4567890 *

When the above command is entered, the controller will screen the telephone number (456-7890) according to the Call Types you have programmed and the Accepted and Rejected Number Tables you have programmed. If the number is acceptable, the controller will send the Dialing Message and dial the number. If the number is not acceptable or the Landline is busy, the controller will send one of the error messages listed above.

AUTOPATCH

ACCESS (without password)

Command Form: (phone number) *

Description: To access the autopatch without the Autopatch Access Password, enter the telephone number you wish to dial (and the "/*", if required). All digits are entered in a continuous string. The phone number may be up to 35 digits in length, and may contain special command digits (A, B, C, D). To access the autopatch in this way, you must turn on the Autopatch Without Password feature.

Acknowledgement: Sends the **DIALING MESSAGE**

Errors:

OFF	Autopatch if Off
? REJ	Rejected (Number was found in Reject Table)
? ERR	Rejected (Number not allowed by Call Type)

Default Condition: The Access Without Password feature defaults to OFF

Examples: Assume that the number you wish to call is 456-7890. Enter the following:

4567890 *

When the above command is entered, the controller will screen the telephone number (456-7890) according to the Call Types you have programmed and the Accepted and Rejected Number Tables you have programmed. If the number is acceptable, the controller will send the Dialing Message and dial the number. If the number is not acceptable, the controller will send one of the error messages listed above.

The autopatch doesn't see the command until AFTER the command has been checked against the passwords and macros. You must watch out for these potential problems when accessing the autopatch without a password:

1. Collisions with macros. If you attempt to dial 911 using the no-password feature, for example, and if a macro named 0911 is found, then the macro will be executed. If no macro is found, then the telephone number will be dialed (assuming the number is acceptable and not rejected).
2. Collisions with passwords. If you attempt to dial 996-3820 using the no-password feature, for example, and if the Master or Control Operator Password is 99 (and assuming that the Control Operator Password is authorized for the 63 command group), then the wrong command will be executed: the Link Control Path 2 command (99 63 82 0 *) will be executed instead of the telephone number being dialed.

AUTOPATCH

ACCESS WITHOUT PASSWORD ON/OFF

Command Form: (PW) 63 11 (0 = disable/1 = enable) *

Description: The Autopatch can be accessed in two ways: With Autopatch Access Password and Without Autopatch Access Password. To allow the autopatch to be accessed without using the Autopatch Access Password, the feature must be enabled with this command.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: OFF

Examples: Assume that the access Without Password feature is OFF, and you wish to turn it ON. Enter the following:

(PW) 63 11 1 *

To turn the Access Without Password feature OFF, enter the following:

(PW) 63 11 0 *

AUTOPATCH

DIALING NOTES

The Autopatch dialer software looks for the lettered characters B, C, and D in a phone number. The purposes of these characters are as follows:

B = pause in dialing (5 seconds)

C = dial the digits that follow in pulse (rotary) mode

D = dial the digits that follow in DTMF mode

You will need a 16-button DTMF keyboard to enter these characters. (If you program a phone number containing the B, C, or D characters into a macro, and if this macro name does not have any lettered characters, then a standard 12-button keyboard can be used to execute the macro.)

As you can see, the lettered characters are useful in instructing the controller how to dial a special number. The lettered characters themselves are not dialed. The call screening process (Call Type Table, Accepted Number Table, and Rejected Number Table) ignores the lettered characters; you may freely place Bs, Cs and Ds in a phone number and still have the number accurately screened for restrictions. When a telephone number has both rotary and DTMF dialing modes in it, it requires that the **Mixed Mode Dialing Option** be enabled.

The lettered characters have only a temporary effect. Once the phone number is dialed, the dialer will assume that the next call will be dialed using the standard mode (the **Dialing Mode** command is used to select the standard mode).

Let's use some examples to illustrate this feature. Assume that the standard mode of dialing is rotary. Assume that you must dial a local 7-digit number, such as 987-6543, pause for a second dial tone, then dial another number in DTMF, such as 234 567 890. Enter your telephone number like this:

987 6543 B D 234 567 890 *

You will have to make an entry into the accepted Number Table so that the controller will allow this 16-digit number. You can allow 98765432345678890, or you can allow sixteen "A"s (which will allow any 16-digit number to be dialed). In the above example, the controller would dial 9876543 in rotary (pulse) format; pause 5 seconds; then dial 234567890 in DTMF.

AUTOPATCH

CONVERSATION CONTROL NOTES

During a standard half-duplex autopatch, the mobile operator always has control of the conversation. When the mobile is transmitting, audio from the receiver is fed to the phone line. Audio from the phone line is not allowed to feed the transmitter. If autopatch privacy is turned off, then the mobile audio is allowed to repeat. If auto patch privacy is turned on, the mobile audio is not allowed to repeat.

When the mobile is listening, audio from the receiver is not allowed to feed the phone line. Audio from the phone line is fed to the transmitter.

With this scheme, the mobile operator can cut off the telephone party by simply pressing the PTT button.

During a full-duplex autopatch, audio feeds both ways for the duration of the conversation. Operators do not have the ability to cut off the telephone party with PTT, but must control the call with only the Dump command.

AUTOPATCH

ACCESS PASSWORD

Command Form: (PW) 23 (new access password) *

Description: Assigns a new Autopatch Access Password. The Autopatch Access Password must be 2, 4, or 6 digits in length, and can be any combination of 0-9 and A-D.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered

Default Condition: Access Password is 10

Examples: Assume that the access password is 10, and that you wish to change it to A5. (Note that this will prevent users without 16-button DTMF pads from accessing the autopatch). Enter the following command:

(PW) 23 A5 *

Note that the (PW) in the above example refers to the Master or Control Operator password. The Autopatch Access Password has no power to modify control functions; it is only used to access the autopatch.

AUTOPATCH

CALL COUNTER

Command Form:	Clear the Call Counter Send the Call Count	(PW) 69 * (PW) 86 *
Description:	The autopatch Call Counter keeps track of the number of autopatch calls attempted. (A call is "attempted" if the controller accepts the phone number as being valid and begins to dial.)	

The Call Counter starts at 000 and increments by one for each call. After reaching 999 calls, the counter will start over at 000. The counter may be read in CW by entering the Send the Call Count command. You can clear the counter (force it to 000) by entering the Clear the Call Counter command.

Uses for the Call Counter include monitoring autopatch activity, and reducing the activity in cases where there are monthly limits on the number of calls allowed.

Acknowledgement: CALLS xxx or CALLS 000 (if clear)

Errors: ? ERR 1 wrong number of digits entered

Default Condition: Counter is set to 000

Examples: Assuming that fifteen autopatch calls have been made since the counter was last cleared, enter the following command:

(PW) 86 *

The following CW message will be sent in response:

CALLS 015

AUTOPATCH

CALL TYPES

Command Form: (PW) 60 (list0-7/none=OFF) *

Description: Selects the types of calls permitted by the autopatch. Enter up to 8 digits from the table below:

(none)	no calls permitted (autopatch off)
0	ACCEPTED calls
1	0 (Operator)
2	XXX-XXXX (local calls)
3	0-XXX-XXXX (operator-assisted 7-digit calls)
4	1-XXX-XXXX (direct dial 7-digit calls)
5	0-(XXX)-XXX-XXXX (operator-assisted 10-digit calls)
6	1-(XXX)-XXX-XXXX (direct dial 10-digit calls)
7	1-(800)-XXX-XXXX (toll free calls)

(Entering any digit 0-7 will permit Accepted numbers)

NOTE: Entering this command will dump any autopatch call in progress, and clear the re-dialer memory.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: Autopatch Off

Examples: To turn the autopatch off, enter the following command:

(PW) 60 *

To permit only Accepted numbers, operator calls, and local calls, enter the following command:

(PW) 60 0 1 2 * or

(PW) 60 1 2 *

Note: The 0 (zero) data digit is not needed, as entering any digit 0-7 will permit Accepted numbers.

AUTOPATCH

DIALING MODE

Command Form: (PW) 61 (1=10 pps/2=20 pps/3=DTMF) *

Description: This command selects the autopatch dialing default mode (the mode can be changed during dialing with embedded C and D characters). Ten PPS (pulses per second) rotary is the standard method. Twenty PPS works on some exchanges. DTMF (dual tone multi-frequency or Touch Tone) will work if you have the service in your area and have a Touch Tone line connected to the controller.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 10 PPS rotary

Examples: To change the dialing mode to DTMF, enter the following:

(PW) 61 3 *

To change the dialing mode to 20 PPS, enter the following:

(PW) 61 2 *

To change the dialing mode to 10 PPS, enter the following:

(PW) 61 1 *

AUTOPATCH

DIALING MIXED-MODE ON/OFF

Command Form: (PW) 63 04 (0=off/1=on)*

Description: This command controls whether or not mixed-mode dialing is allowed. Mixed mode dialing means that both rotary and DTMF dialing is allowed using the B, C, and D lettered characters in the phone number. If mixed-mode dialing is turned off, the controller will ignore any letter characters in the phone number.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: Mixed-mode dialing is off

Examples: To turn mixed-mode dialing on, enter the following:

(PW) 63 04 1 *

To turn mixed-mode dialing off, enter the following:

(PW) 63 04 0 *

AUTOPATCH

DUMP (HANG UP)

Command Form: (PW) 83 *

Description: This command terminates either an autopatch or a reverse patch call. Since you will not want to divulge the password system to the autopatch users, we suggest that this command be placed into a macro of your choice. The macro would be used to dump all calls. Note that the controller also supports pound-down dumping, described in the POUND DOWN command section.

Acknowledgement: none

Errors: none

Default Condition: none

AUTOPATCH

ACCESS/DUMP TRIGGERED MACROS

Command Form: Access-Triggered Macro (PW) 26 12 (macro name)*
Dump-Triggered Macro (PW) 26 13 (macro name)*

Description: The Accessed-Triggered and Dump-Triggered macro commands make the autopatch more flexible. For example, a tape recorder can be turned on and off by connecting it to a logic output. The tape recorder could be activated or deactivated by the Autopatch Access and Dump macros. The tape recorder can be located at a remote location from the repeater connected to a CTCSS decoder and receiver on the repeater's output frequency. The Autopatch Access and Dump macros can turn the controller's CTCSS encoder on and off, and change its frequency.

NOTE: The Autopatch Dump Macro will be executed if the autopatch times out. If a series of calls are made without dumping the autopatch between calls, the Dump Macro will be executed at the end of the last call.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: no macros are assigned

AUTOPATCH

FULL DUPLEX ON/OFF

Command Form: (PW) 63 07 (0=off/1=on)*

Description: This command places the autopatch in or out of the full-duplex mode. Normal operation of the autopatch is in half-duplex mode, which means audio is gated from the phone line to the transmitter when the mobile is listening, and gated from the receiver to the phone line when the mobile is talking. Full-duplex operation means audio is gated both ways at the same time, allowing the mobile to talk and listen simultaneously (assuming the mobile is equipped with full-duplex RF gear). A disadvantage of full-duplex operation is that the mobile cannot simply press the PTT button to quiet the voice of the phone party. Note that if the Privacy feature is turned on, the autopatch will be in half-duplex even if Full Duplex is turned on.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: off

Examples: To turn full-duplex on, enter the following command:

(PW) 63 07 1 *

AUTOPATCH

MUTE DTMF TO PHONE LINE ON/OFF

Command Form: (PW) 63 08 (0=off/1=on) *

Description: This command is used to allow or disallow DTMF to be passed from the repeater receiver to the phone line. It does not affect the dialing of phone numbers, since it is in effect after dialing is finished. The purpose of this command is to prevent troublemakers from dialing a second phone number after a called party hangs up. (Some exchanges return a second dial tone under those conditions.) DTMF digits are detected and muted from the phone line when this feature is turned on. It would have to be turned off, however, when a mobile station wishes to call a number and remotely control a device via DTMF.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: off

Examples: To turn on Mute DTMF to Phone Line, enter the following command:

(PW) 63 08 1 *

AUTOPATCH

POUND (#) DOWN ON/OFF

Command Form: (PW) 63 05 (0=off/1=on)*

Description: Some customers want the ability to dump (hang up) the autopatch by entering just the # key. If this feature is turned on, the autopatch can be dumped with the # key as well as the other methods (control command or macro). If this feature is turned off, the autopatch can be dumped only with the control command (or a macro containing the control command).

Note that the # key still retains its other meaning (clear the command buffer) whether this feature is on or off. That is, if the # key is pressed when a partial command is in the command buffer, the controller will clear the command buffer but will not dump any autopatch or reverse patch in progress at that time. Only when this command is on, and the command buffer is empty, will the # key dump an autopatch or reverse autopatch.

Since the # key needs to be pressed for only a short time, it is easy for troublemakers to dump a call in progress. That is the reason for allowing the pound down feature to be turned on and off.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: off

Examples: To turn the pound down feature on, enter the following command:

(PW) 63 05 1 *

AUTOPATCH

PRIVACY ON/OFF

Command Form: (PW) 63 06 (0=off/1=on)*

Description: This command turns the Mobile Privacy feature on or off. When on, the audio from the repeater receiver is not transmitted (repeated) during an autopatch, thus preventing others from hearing the mobile side of the autopatch on the repeater output frequency. When off, the audio from the repeater receiver is transmitted (repeated) similarly to the normal operation of the repeater. This command is NOT modal; the controller resets to the default condition (off) after each autopatch.

Since Privacy prevents portions of the conversation from being monitored on the repeater output, control operators shouldn't allow it when autopatches might be used for prohibited purposes.

This command will override the Full Duplex autopatch mode if turned on.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 illegal digit entered

Default Condition: off

Examples: To turn the Privacy feature on for the next autopatch, enter the following command:

(PW) 63 06 1 *

AUTOPATCH

REDIAL LAST NUMBER

Command Form: (PW) 84 *

Description: This command allows you to redial the last number dialed by the autopatch without entering the entire access code and phone number again. This feature is particularly useful if the number you called was busy or not answered. The command works up to 30 minutes from the time the last call was placed. If more than 30 minutes have elapsed, the controller will send CLR (dialer cleared) in CW. The 30-minute timer will be reset after each redial attempt.

It is recommended that users not use the Redial Last Number command if they have not been monitoring the repeater for a while, since another call may have been placed since their call.

The dialer memory is cleared during a warm or cold start; when the autopatch Call Type command is used; after a 30-minute timeout; and when the Clear Redialer command is entered.

Macros created for autopatch “speed dialing” also leave a number in the dialer memory. Therefore, entering a Redial Last Number command following one of these macros will result in a call to the speed dialed party.

An attempt to access the autopatch that is not successful, such as dialing a long-distance number that is rejected, will not clear the redialer or affect the redialer timer.

Acknowledgement: none

Errors: ? ERR 1 wrong number of digits entered
 CLR dialer memory is empty (cleared)

Default Condition: the dialer memory is cleared

AUTOPATCH

CLEAR REDIALER

Command Form: (PW) 85 *

Description: This command clears the autopatch redialer memory. If you do not want users to be able to redial the last number dialed, you should include this command in the Autopatch Dump-Triggered macro, thereby clearing the redialer after each autopatch.

Acknowledgement: none

Errors: none

Default Condition: none

AUTOPATCH

RESTRICTIONS

A feature of the autopatch is the ability to restrict calls to certain groups of telephone numbers. You do this by placing phone numbers into two tables in the controller's memory: a table of Accepted numbers and a table of Rejected numbers. Each time an autopatch call is placed, the telephone number is checked against the tables. The controller then decides whether to allow the call to go through.

The Accept and Reject tables may contain specific telephone numbers, or they may contain telephone numbers with *wildcard* characters (DTMF "A"). The use of wildcard characters allows *groups* of Accepted or Rejected numbers to be compared to the number being dialed.

There are many uses for call restriction. Certain troublesome numbers can be placed in the Reject table, making the number unavailable via command or macros. These could include commercial phone numbers, or perhaps the phone numbers of club members owing dues. In some areas, it is possible to place toll calls to another exchange by dialing only a 7-digit number. To prevent the repeater phone line from accumulating monthly toll charges, simply place the local exchange numbers in the Accept table, and program the Call Types for Accepted numbers only.

In some areas, important numbers (such as police, fire, or ambulance) require a long distance call. Since the owner may not want to open the repeater to all toll calls, he may simply program those few important numbers into the Accept table. Other toll calls will not be permitted if the Call Types list does not include them.

Since the Call Types table does not include all types of calls that exist, the restrictions feature may be used again. For example, some areas of the country have 911 emergency service. The Call Types command does not have a category for 3-digit numbers, so 911 may be placed into the Accept table.

NOTE: You may not want the autopatch to be able to call 911. The coverage area of the repeater may overlap into different emergency organization service areas or 911 dispatch centers, a 911 call may delay the required emergency response because of telephone company routing of the call to the wrong location. Many 911 systems in use display the address of the 911 call to the dispatcher, this could cause some confusion (you may want to notify the 911 dispatch center that the telephone number used by the autopatch is connected to a mobile radio system).

Check with the 911 answering organization before allowing direct dialing of the 911 number. You may want to create autodial macros to route emergency calls to the correct dispatch center. With repeater coverage areas covering multiple communities, counties and states, the routing of emergency calls is **VERY IMPORTANT** to save valuable time and reduce confusion.

AUTOPATCH

RESTRICTIONS - ACCEPTED NUMBERS

Command Form: (PW) 68 (phone number/nothing = clear table) *

Description: This command allows you to enter a phone number into the Accepted Number table. Up to 20 entries are permitted. The phone number may be a specific number or it may contain one or more "A" characters as wildcards. Enter only one phone number per command. Entering *nothing* after the 68 clears the Accepted Number table.

Acknowledgement: OK

Errors:

? ERR 1	wrong number of digits entered
? ERR 2	illegal digit entered (B, C, or D)
? FULL	table is full

Default Condition: table is empty

Examples: To program all numbers in the 234 exchange into the Accepted Number table, enter the following:

(PW) 68 234 AAAA *

To program all numbers in the 800 area code (toll free) into the Accepted Number table, enter the following:

(PW) 68 234 AAAA *

To program 911 into the Accepted Number table, enter the following:

(PW) 68 911 *

To clear the Accepted Number table, enter the following:

(PW) 68 *

AUTOPATCH

RESTRICTIONS - REJECTED NUMBERS

Command Form: (PW) 67 (phone number/nothing = clear table) *

Description: This command allows you to enter a phone number into the Reject Number table. Up to 20 entries are permitted. The phone number may be a specific number or it may contain one or more "A" characters as wildcards. Enter only one phone number per command. Entering *nothing* after the 68 clears the Rejected Number table.

Acknowledgement: OK

Errors:

? ERR 1	wrong number of digits entered
? ERR 2	illegal digit entered (B, C or D)
? FULL	table is full

Default Condition: table is empty

Examples: To program all numbers in the 976 exchange into the Rejected Number table, enter the following:

(PW) 67 976 AAAA *

To program all numbers in the 900 area code into the Rejected Number table, enter the following:

(PW) 67 1 900 AAA AAAA *

To program 0 (operator) into the Rejected Number table, enter the following:

(PW) 67 0 *

To clear the Rejected Number table, enter the following:

(PW) 67 *

AUTOPATCH

REVERSE PATCH - TRIGGER

Command Form: (PW) 87 *

Description: The Reverse Patch feature allows users to dial the repeater telephone number from a landline and be connected to a repeater user. The Reverse Patch can be used in two ways: the controller can announce that a user has dialed the site, or the controller can wait for a DTMF command from the telephone party before announcing. In the first mode, the telephone party never has access to the DTMF decoder; the only function that a call to the repeater telephone number has is to trigger a reverse patch message. In the second mode, the telephone party is similar to a control operator; he will be able to enter any command. To trigger a reverse patch, the proper command will have to be entered from a Touch Tone telephone.

The first mode may be necessary in several situations. For example, in areas without Touch Tone service, the controller will have to be configured to trigger a reverse patch message without requiring a command. Other exchanges reverse the polarity of the telephone line loop voltage going to the telephone set after the dialing process is complete; this disables the DTMF encoder in the telephone. These situations can be fixed by using a separate DTMF encoder in the first case, and using a bridge rectifier to feed unipolar DC to the DTMF encoder in the second case. However, it will still be difficult to trigger the reverse patch from some pay phones (or a phone not equipped with DTMF capability) in rotary exchanges.

When the Reverse Patch Trigger command is entered from the landline, the command causes the reverse patch sequence to start. The DTMF decoder is switched from the landline back to the repeater receiver. Note that this command only works from the landline, and that the error message is sent to the landline.

Acknowledgement: Starts Reverse Patch sequence, sends Ringout Message

Errors: ? ERR 1 wrong number of digits entered

Default Condition: none

AUTOPATCH

REVERSE PATCH - ANSWER

Command Form: (PW) 88 *

Description: When entered via the repeater receiver, this command connects the telephone party to the repeater. The call progresses the same way as a standard autopatch.

Acknowledgement: none

Errors: ? ERR 1 wrong number of digits entered

Default Condition: none

AUTOPATCH

REVERSE PATCH - RINGOUT MESSAGE

Command Form: Ringout Message (PW) 31 51 (message) *
Ringout Message Review (PW) 34 51 *

Description: This message is sent over the repeater transmitter when the reverse patch is triggered. The message is repeated at each ring or at timed intervals, depending on the Landline Answer Mode. Make the message reasonably short to prevent messages from becoming stacked up in the message buffer.

Acknowledgement: OK

Errors: none

Default Condition: the ringout message is 55 in CW

AUTOPATCH

TIMEOUT TIMER - RESET

Command Form: (PW) 81 *

Description: This command resets the Autopatch Timeout Timer, allowing the autopatch call to continue for another period of time as selected by the Autopatch Timeout Timer command. If the call reaches the time limit, the controller will terminate the call. When the timer is within 30 seconds of timing out, the controller will start sending short (programmable) warning messages every 5 seconds.

Acknowledgement: none

Errors: none

Default Condition: none

AUTOPATCH

TIMEOUT TIMER

Command Form: (PW) 65 (.1-54.6 min/000=infinity) *

Description: This command programs the maximum duration of an autopatch call. After the root number, enter 1 to 3 digits representing the desired time in tenths of minutes. The range of the timer is 0.1 minutes to 54.6 minutes. Leading zeros are not required, so entering 030 for 3.0 minutes is the same as entering 30. Enter 000 for infinity (timer disabled).

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered or out of limit

Default Condition: 3.0 minutes

Examples: To set the autopatch Timeout Timer to 4.5 minutes, enter the following:

(PW) 65 45 *

To set the autopatch Timeout Timer to infinity (disable the timer), enter the following:

(PW) 65 000 *

AUTOPATCH

TIMEOUT WARNING MESSAGE

Command Form: Timeout Warning Message (PW) 31 41 (message) *
 Timeout Warning Message Review (PW) 34 41 *

Description: The controller sends the Timeout Warning Message every five seconds for the last 30 seconds of the autopatch call timeout period. If the mobile station unkeys for a few seconds during the last 30 seconds of the timer period, the operator will hear the warning message and recognize that the autopatch is about to be terminated.

Acknowledgement: OK

Default Condition: the message is AR in CW

CLOCK

INTRODUCTION

The controller features a software clock and calendar. As long as power is supplied to the controller, it will keep proper time. The calendar does not have leap-year correction.

CLOCK CORRECTION

Command Form: (PW) 19 (00-59 sec., 0=slower/1-faster) *

Description: This command allows you to "tweak" the clock for precise accuracy.

Acknowledgement: OK

Errors: ? ERR 1
? ERR 2

Default Condition: No correction is assumed

Examples: Assume that the clock is running one minute fast per month. The daily correction would be 60 seconds divided by 30 days, or 2 seconds per day. The clock should be running 2 seconds per day slower. The command would be:

(PW) 19 02 0 *

As a second example, assume that the clock is running 5 seconds slow per day. The correction command would be:

(PW) 19 05 1 *

It will require several days to note the amount of correction needed, since it will become obvious only after at least 1 minute of error accumulates. Therefore, you should divide the number of seconds of error by the number of days over which it accumulated: this will yield the daily correction.

Note that corrections are not cumulative; a correction of 2 seconds fast, followed by a correction of 4 seconds fast does NOT result in 6-second fast correction. So, if subsequent checks show the need for additional correction, the old correction value should be replaced with a slightly larger or smaller correction value. Setting the clock and calendar does not affect the correction. If the clock is changed for daylight savings time, for example, its accuracy will not be affected.

CLOCK

SEND TIME OR DATE

Command Form: (PW) 14 (1=time 12hr/2=time 24hr/3=date) *

Description: Sends the current time in CW. Enter one digit for the format:

- 1 = time of day in 12-hour format
- 2 = time of day in 24-hour format
- 3 = month and day

Acknowledgement: Format 1: Time xx xx AM or Time xx xx PM (1:00-12:59)
Format 2: Time xx xx (00:00 - 23:59)
Format 3: xxx xx (Jan 1 - Dec 31)

Errors: ? NOT SET clock has not been set.

Default Condition: Time and date are not set

Examples: In these examples, assume that the time is 1:35 PM and the date is March 5.

To get the 12-hour time, enter:

(PW) 14 1 *

The controller will send: Time 1 35 PM

To get the 24-hour time, enter:

(PW) 14 2 *

The controller will send: Time 13 35

To get the date, enter:

(PW) 14 3 *

The controller will send: MAR 5

CLOCK

SET TIME AND DATE

Command Form: (PW) 18 (hours, minutes, months, day) *

Description: Sets the clock and the calendar. Enter two digits for the hours in 24-hour format, two digits for the minutes, two digits for the month, and two digits for the day. The acceptable ranges are as follows:

hours	00 - 23
minutes	00 - 59
month	01 - 12 (January is 01)
day	01 - 31

Acknowledgement: Sends the time and date in CW

Errors:	? ERR1	wrong number of digits entered
	? BAD HRS	hours were over 23
	? BAD MIN	minutes were over 59
	? BAD MONTH	month was 00 or over 12
	? BAD DAY	day was 00 or over 31

Default Condition: Time and date are not set

Examples: Assume that the time is 3:21 PM and the date is June 10.

In 24-hour format, the time is 15:21. The month is 06 and the day is 10. The command would look like this:

(PW) 18 15 21 06 10 *

As a second example, assume that the time is 9:45 AM and the date is December 3. Since two digits are needed for the hour, a leading zero is inserted. The command would look like this:

(PW) 18 09 45 12 03 *

CW

CW DISABLE/ENABLE

Command Form: (PW) 63 01 (0 = disable/1=enable) *

Description: This command disables or enables the CW sending function

Acknowledgement: (nothing) if disabled
OK if enabled

Errors: ? ERR 1 wrong number of digits entered (disable only)
? ERR 2 illegal digit entered (disable only)

Default Condition: enabled

CW

SLOW NEXT MESSAGE

Command Form: (PW) 11 *

Description: Entering this command before entering a command with a CW message causes the CW message to be sent at the speed set by the Speed Select (Slow) command. This command is most useful when placed into a macro for users. CW speed returns to normal after the message buffer is empty.

Acknowledgement: none

Errors: none

Default Condition: CW is sent at the Speed Select (Normal) rate.

Examples: Assuming that macro 3 * sends the 12-hour time, and macro 2 * contains the Slow Message command. A user could enter:

2 *
3 *

This will cause the time-of-day to be sent at the Speed Select (slow) rate.

Note: The repeater Courtesy Message is also a CW message. If a user enters 2 * and then releases his PTT switch, the courtesy message will be sent at the Speed Select (slow) rate. Since the speed then changes back to normal, entering a 3 * will cause the time to be sent at the Speed Select (normal) rate. Therefore, the user must enter the 2 * and 3 * in the same transmission.

CW

SPEED SELECT

Command Form: Speed Select (Normal)(PW) 12 (0-9) *
Speed Select (Slow) (PW) 13 (0-9) *

Description: Speed Select (Normal) changes the speed at which CW messages are normally sent. Speed Select (Slow) changes the speed at which CW messages are sent when preceded by the Slow Next Message command. A single digit programs the desired speed as indicated in the table below:

0 = 5 WPM	5 = 17 WPM
1 = 7 WPM	6 = 20 WPM
2 = 10 WPM	7 = 24 WPM
3 = 13 WPM	8 = 30 WPM
4 = 15 WPM	9 = 40 WPM

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: Normal = 20 WPM
Slow = 15 WPM

Examples: To change the normal CW sending speed to 17 WPM, enter:

(PW) 12 5 *

To change the slow CW sending speed to 10 WPM, enter:

(PW) 13 2 *

Note: There are two ways to change the speed of a CW message. One way is to use the command above; this is usually done upon installation. The other method is to insert a speed change character into the message. This is a temporary method, since the speed returns to normal after the message buffer empties.

DTMF DECODER

ACCESS MODE - RX1

Command Form: (PW) 57 06 (mode 0-5) *

Description: This command selects one of six DTMF decoder access modes for RX1:

- | | |
|--------|--|
| Mode 0 | No Access. Activity on the COR and CTCSS inputs is ignored; only the control receiver receives commands. |
| Mode 1 | Carrier Access. Activity on the COR input will allow access to the DTMF decoder. Activity on the CTCSS input is ignored. |
| Mode 2 | CTCSS Access. Activity on the CTCSS input will allow access to the DTMF decoder. Activity on the COR input is ignored. |
| Mode 3 | AND-CTCSS Access. Activity on both the COR and CTCSS inputs simultaneously will allow access to the DTMF decoder. |
| Mode 4 | OR-CTCSS Access. Activity on the COR input or the CTCSS input will allow access to the DTMF decoder. |
| Mode 5 | Anti-CTCSS Access. Activity on the COR input simultaneously with no activity on the CTCSS input will allow access to the DTMF decoder. |

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: Mode 1 (Carrier Access)

Examples: Assume that the DTMF decoder is in carrier access, and that CTCSS access is desired. The proper command would be:

(PW) 57 06 2 *

A better mode for many repeater installations is mode 3, AND-CTCSS access. This mode has better rejection of adjacent channel interference than Mode 2, since noise falsing from unsquelched audio is eliminated. Enter this command:

(PW) 57 06 3 *

Mode 4 allows both carrier access and CTCSS operation. Since CTCSS is more easily detected, CTCSS users will find increased range. Carrier access users are unaffected. The squelch may be tightened to suppress band-opening problems. ANTI-CTCSS is used when the repeater is co-channel with another, CTCSS accessed repeater. Users of the second system are kept out of the DTMF decoder with the ANTI-CTCSS system.

DTMF DECODER

INTERDIGIT TIMER

Command Form: (PW) 82 (01-99) *

Description: This command programs the maximum amount of time allowed between DTMF digits received by the controller. If a delay occurs that is greater than the value specified in the command, then the command buffer will be cleared.

Enter two data digits in the range 01 to 99, representing 0.1 to 9.9 seconds.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 5.0 seconds

DTMF DECODER

MUTE DELAY

Command Form: (PW) 96 (0-9) *

Description: This command selects the duration of the muting that occurs after a DTMF digit is received by the controller. Enter one data digit representing the delay duration .0 through .9 seconds.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 0.5 seconds

Examples: When the controller recognizes a DTMF digit, it mutes the audio so that the digit is not retransmitted. (Since some time is required by the controller to decode the digit, a short burst of tone is retransmitted). A timer is started for the purpose of delaying the unmuting. This allows a string of DTMF digits to be entered, with all but the first one fully muted. The command shown above controls this timer. If set to 0 (zero), the muting will end when the DTMF digit is released. If set to 9, the muting will last 0.9 seconds beyond the release of the DTMF digit. Since a voice will occasionally trip the DTMF decoder, a long mute delay may not be desired.

If a DTMF digit is held down for a continuous period of time, the controller will stop muting after 10 seconds.

To change the mute delay to 0.3 seconds, enter the following command:

(PW) 96 3 *

DTMF DECODER

MUTE ON/OFF

Command Form: (PW) 63 03 (0 = disable/1 = enable) *

Description: This command turns ON or OFF the controller's ability to mute DTMF tones from the repeater receiver.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: ON (enabled)

Examples: Muting is usually left ON (enabled) to prevent DTMF digits from being repeated, and to prevent listeners from learning macro and command codes. Sometime it is necessary to signal devices through the repeater, and during these occasions the muting may be turned OFF (disabled).

To turn OFF (disable) the muting of DTMF tones, enter the following command:

(PW) 63 03 0 *

IDENTIFIER

INTRODUCTION

This first signal to be received will start the ID cycle. The ID'er is polite and will wait for the signal to disappear. It then sends the INITIAL ID message in CW, and executes the INITIAL ID MACRO. (If, however, the signal is received continuously until the ID timer timeout is reached, then the controller will send the INITIAL ID message in CW and execute the IMPOLITE MACRO).

During the conversation, the controller will keep looking for a carrier drop during the 30 seconds prior to the ID timer timeout. If it finds such a point, it sends the NORMAL ID message in CW and executes the NORMAL ID MACRO. If it cannot find such a break, it will send the NORMAL ID message in CW and execute the IMPOLITE ID MACRO. (When selecting the ID time interval, keep in mind that the selected interval is the maximum interval between IDs, and that IDs may occur up to 30 seconds early).

If the QSO is over and the ID timer times out, the controller will send the NORMAL ID message in CW and execute the POLITE ID MACRO. It will not ID again until a new cycle is begun.

Several possibilities are open to the repeater trustee. You may wish to delete the NORMAL and INITIAL CW messages, and operate the ID'er from three macros. In this way, synthesized voice message might greet the initial user with callsign and frequency information; or, you may pulse an external tape cartridge machine. The POLITE ID macro may contain a short synthesized or CW message. The IMPOLITE ID macro should probably be a short CW message since it will be sent "on top" of the transmitting station.

IDENTIFIER

ID-TRIGGERED MACROS

Command Form:	Impolite ID Macro Initial ID Macro Polite ID Macro	(PW) 26 05 (macro name) * (PW) 26 03 (macro name) * (PW) 26 04 (macro name) *
Description:	These commands assign macros to be triggered at the appropriate ID times. Enter the 4-digit macro name desired. To delete the assignment, enter no macro name.	
Acknowledgement:	OK	
Errors:	? ERR 1 wrong number of digits entered ? ERR 2 illegal digit entered	
Default Condition:	no macros assigned	
Examples:	ID-triggered macros may be used when it is desirable to play a cartridge tape. For example, a macro may be created that pulses one of the logic outputs; this is wired to the start line of a cartridge machine. That macro may be programmed into the Initial ID Macro, so that the taped message occurs only on initial IDs.	

Assume that a macro 1200* is to be executed for an initial ID; macro 1201* is to be executed for a polite ID; and macro 1202* is to be executed for an impolite ID. The following command would be entered:

(PW) 26 03 1200 *
(PW) 26 04 1201 *
(PW) 26 05 1202 *

IDENTIFIER

INTERVAL

Command Form: (PW) 51 (5-300) *

Description: This command programs the maximum interval at which IDs occur. Because of the polite nature of the identifier, an ID may earlier if there is a recent carrier drop.

Enter one to three data digits in the range of 5 to 300, representing .5 to 30.0 minutes.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 3.0 minutes

Examples: To change the ID interval to 4.5 minutes, enter:

(PW) 51 45 *

To change the ID interval to 9.9 minutes, enter:

(PW) 51 99 *

IDENTIFIER

RESET INITIAL TO NORMAL

Command Form: (PW) 54 *

Description: This command causes the Initial ID message to be the same as the Normal ID message.

Acknowledgement: Sends the ID

Errors: ? ERR 1 wrong number of digits entered

Default Condition: Both ID messages are the letters "ID"

Examples: On occasion, you may want to change the Initial ID message to something special. For example, you could program W8ABC/R MRY XMAS, or W2XYZ/R SWAPFEST SAT, etc. When the season or event is over, simply enter:

(PW) 54 *

The Initial ID will now become the same as the Normal ID, which is probably a short message. When another special message is desired for the Initial ID, reprogram the Initial ID using the Callsign (Initial ID) command.

IDENTIFIER

SEND ID

Command Form: (PW) 55 *

Description: This command causes the identifier to send the Initial ID, followed by the Initial ID Tail Message.

Acknowledgement: Sends Initial ID and Tail Message

Errors: ? ERR 1 wrong number of digits entered

Default Condition: none

IDENTIFIER

TAIL MESSAGES

Command Form: (PW) 50 (0=initial/1=normal) (tail number) *

Description: Tail messages are short CW messages that can be appended to Initial ID and Normal ID messages.

The tail number can be nothing, one data digit [0-9], or two data digits [10-15]. The following are the available tail messages:

0	(no message)	9	WARN
1	FEST	10	RACES
2	DUES	11	TGIF
3	MEET	12	/R
4	NET	13	LINK
5	HI	14	RMT (remote)
6	WX	15	BAT
7	ALERT	(none)	(no message)
8	WATCH		

Acknowledgement: Initial ID tail: Sends ID plus tail, and cycles ID'er
Normal ID tail: Sends ID plus tail

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: Both tail messages default to (none).

Examples: To have HI (tail message 5) appended to the Initial ID, and TGIF (tail message 11) appended to the Normal ID, enter:

(PW) 50 0 5 *
(PW) 50 1 11 *

LANDLINE CONTROL

ANSWER MESSAGE

Command Form: (PW) 31 50 (message) *

Description: This command allows you to select the message that the controller sends when it answers the landline. The message is sent to the caller.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 0.5-second delay, then 3 beeps

LANDLINE CONTROL

LANDLINE CONTROL TIMER

Command Form: (PW) 79 (1-546) *

Description: This command is used to reload the landline timer. For example, if you will be programming the controller and will need about ten minutes to do the work, you may load the timer for ten minutes. The timer may be reloaded at any time during that period, as well. Do not load the timer with a very long period of time unless you need it, because if the phone line should become disconnected, the controller will remain off-hook for the duration of the timer.

Enter one to three data digits in the range of 1 to 546, representing 0.1 to 54.6 minutes.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 illegal digit entered

Default Condition: none

LANDLINE CONTROL

LANDLINE ANSWER MODE

Command Form: (PW) 64 (mode 1-4, ring-in delay 00-99, ringout limit 00-99) *
(PW) 64 0 * [mode 0]

Description:

There are five landline answer modes for reverse patch and telephone line control. Mode 0 (zero), "Do Not Answer", has the simplest format with only one data digit. Mode 0 disables the answering of the landline, prohibiting reverse patch and telephone control of the controller.

The ring-in delay is a two-digit number telling the controller how many rings to ignore before performing a job. One of the benefits of having ring-in delay is that it allows someone to pick up the phone if there is a phone in parallel with the controller. Some repeaters share a phone line with the maintenance crew at a radio or TV site. So, for example, if no one picks up the phone after 8 rings, then the controller can assume the call is for it.

The ringout limit is a two-digit number telling the controller the maximum number of times to send the reverse patch ringout message. If a control operator is programming the controller, for example, and then triggers the reverse patch by command, the maximum number of ringouts will be set by the ringout limit.

When in control line mode, commands can be entered for a maximum of 40 seconds. If more time is required, you may enter the Control Line Timer command to "buy" more programming time. The timer can be reloaded at any time. Remember, however, that the phone line will be active for the duration of the timer; be sure to dump the phone line when your programming is finished. Otherwise, the line will be busy for the remaining time of the Control Line Timer.

Mode 1 After a delay of 00-99 incoming rings, begin ringout for reverse patch at a rate of one ringout message for each incoming ring. If answered by a mobile, connect. If unanswered by the ringout limit of 00-99 rings, ignore further incoming ringing.

NOTES: In Mode 1, the controller does not connect the calling party to the mobile until the mobile answers the call. The calling party hears only the ringback until actually connected to a mobile. Setting the Ring Delay to zero means that the ringout begins on the first incoming ring; a delay of one (1) means the ringout begins after delaying one ring, or at the beginning of the second ring. Setting the Ringout Limit to zero is the same as putting the controller into Mode 0; it can't ring out with a zero limit, so it will ignore incoming ringing.

Mode 2 After a delay of 00-99 incoming rings, begin ringout for reverse patch at a rate of one ringout message for each incoming ring. If answered by a mobile, connect. If unanswered by the ringout limit of 00-99 rings, connect and go into Control Line mode. Commands may be entered for 40 seconds. The line will then disconnect unless the Control Line Timer

command is used to extend the time.

NOTES: This mode is similar to Mode 1, except the controller will allow access to Control Line mode when the ringout limit is reached. While in Control Line mode, another reverse patch command could be entered if desired. Setting the Ringout Limit to zero is the same as putting the controller into Mode 3; it can't ring out with a zero limit, so it will go into control line mode after the delay is finished.

Mode 3 After a delay of 00-99 incoming rings, connect and go into Control Line mode. Commands may be entered for 40 seconds. The line will then disconnect unless the Control Line Timer command is used to extend the time.

NOTES: Setting the delay to zero means that the controller will answer on the first incoming ring; a delay of 1 means that the controller will answer after delaying one ring, or on the second incoming ring. The Ringout Limit serves to set the number of ringouts if the reverse patch trigger command is entered. If the limit is set to zero, the line will disconnect when a reverse patch trigger command is entered.

Mode 4 After a delay of 00-99 incoming rings, connect and go into Control Line mode. The controller will look for DTMF digits; if no DTMF digits are received in 40 seconds, it will begin ringout for reverse patch at the rate of one ringout message every 6 seconds. If answered by a mobile, connect. If unanswered by the ringout limit of 00-99 rings, disconnect. If DTMF digits are received in the first 40 seconds, go into Control Line mode. The controller will not ring out for reverse patch. Commands may be entered for the balance of the 40 seconds. The line will then disconnect unless the Control Line Timer command is used to extend the time.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 illegal digit entered

Default Condition: Mode 3, ring-in delay = 2, ringout limit = 10

LOGIC INPUTS

ASSIGN MACROS TO LOGIC INPUTS

Command Form: Logic Input #1 Hi-to-Lo(PW) 26 20 (macro name) *
Logic Input #1 Lo-to-Hi(PW) 26 21 (macro name) *
Logic Input #2 Hi-to-Lo(PW) 26 22 (macro name) *
Logic Input #2 Lo-to-Hi(PW) 26 23 (macro name) *
Logic Input #3 Hi-to-Lo(PW) 26 24 (macro name) *
Logic Input #3 Lo-to-Hi(PW) 26 25 (macro name) *

COR #1 Input Hi-to-Lo (PW) 26 34 (macro name) *
COR #1 Input Lo-to-Hi (PW) 26 35 (macro name) *
COR #2 Input Hi-to-Lo (PW) 26 36 (macro name) *
COR #2 Input Lo-to-Hi (PW) 26 37 (macro name) *

PL #1 Input Hi-to-Lo (PW) 26 40 (macro name) *
PL #1 Input Lo-to-Hi (PW) 26 41 (macro name) *
PL #2 Input Hi-to-Lo (PW) 26 42 (macro name) *
PL #2 Input Lo-to-Hi (PW) 26 43 (macro name) *

Description: These commands assign macros to the transitions of the hardware inputs. Enter the password, the 4-digit root number, the macro you want executed on the transition, and the **. If the macro name has fewer than four digits, enter leading zeroes. If you want to unassign a macro that was previously assigned, enter just the password, the 4-digit root number, and the **.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Conditions: no macros assigned

Examples: Let's assume a normally-open intrusion switch is connected with one contact to Logic Input 1 and the other to ground. The switch closes when tripped, causing the logic input to see a high-to-low transition. We want this transition to change the CW pitch.

Let's assume macro 0050 changes the CW pitch to the desired value.

To assign this macro to Logic Input 1's High-to-Low transition, enter:

(PW) 26 20 0050 *

Note that this is a "latched" arrangement. That is, when the switch is tripped and the CW pitch changed, the pitch stays at the new value until commanded back to normal. This may be desirable, since the switch may be tripped late at night when no one is using the repeater. We'd want to

return the pitch to normal after acknowledging the entry, not when the switch goes back to the open state.

Other applications require that the condition not be latched. For example, a 115-VAC relay could be wired with its coil to the 115 VAC line at the repeater site. A pair of SPST contacts could be wired in series between a logic input and ground. When the relay is energized and the contact is closed, the repeater is operating from AC power. When the relay is de-energized and the contact is open, the repeater is operating from battery power. The contact provides this information to the controller via a logic input, and the controller informs the users by appending "BAT" (battery) or a similar message to the repeater tail. Users should be told to limit their transmissions when they hear the BAT message. When AC power is restored, the controller would automatically turn off the BAT message.

This requires two macros, one to program "BAT" into the Dropout Message and one to program (nothing) into the Dropout Message. Assume that macro 0500 programs "BAT" and macro 0501 removes "BAT". To assign these macros to Logic Input 2, enter:

(PW) 26 22 0501 * (removes msg on Logic Input 2 hi-to-lo)
(PW) 26 23 0500 * (programs msg on Logic Input 2 lo-to-hi)

LOGIC OUTPUTS

MOMENTARY OFF
MOMENTARY ON
OFF
ON

Command Form: Momentary Off (PW) 73 (list the outputs) *
 Momentary On (PW) 72 (list the outputs) *
 Off (PW) 71 (list the outputs) *
 On (PW) 70 (list the outputs) *

Description: List the outputs to be controlled by entering 1, 2, or 3, or any combination.

Acknowledgement: OK

Errors: ? ERR 2 illegal digit entered

Default Condition: all outputs OFF (open)

Examples: To turn ON logic output 1, enter:

(PW) 70 1 *

To turn ON logic 2, enter:

(PW) 70 2 * (logic output 1 is still ON)

To turn OFF both logic outputs, enter:

(PW) 71 1 2 *

To momentarily turn ON logic output 1, enter:

(PW) 72 1 *

To momentarily turn ON both logic outputs, enter:

(PW) 72 1 2 *

If logic output 2 is ON, you may momentarily turn it OFF by entering:

(PW) 73 2 *

MACROS

INTRODUCTION

A very powerful feature of the controller is its ability to handle "macro commands". No macros exist until you create them. You create macros with a command that sets aside a storage area, names it, and puts your desired command into it. You can then append additional commands, erase it, list its contents in CW, and rename it. The names of the macros and their contents are fully programmable.

The advantages in using macros include:

The ability to store long commands, then execute them using a short "name"

Time savings for commands that are entered often or contain many characters

Lower chance for errors due to entering fewer digits

Higher system security due to not disclosing actual control commands to users.

Note that the controller does not check the validity of the commands stored in macros. If an error is made in the command stored in a macro, or if a password is changed after a command is stored, the macro will appear to not execute properly.

QUANTITY OF MACROS

The controller supports a total of 200 macros.

NAMES OF MACROS

You choose the name of a macro when you create it. The name may be one, two, three, or four digits long, and may contain any combination of the characters 0 through 9 and A, B, C, and D. You terminate a macro the same way as a control command.

LENGTH OF MACROS

Each macro may contain a maximum of 54 digits. This number is decreased by two for each additional command stored in a macro, and decreased by one more if the command contains an odd number of digits. Thus, a macro may contain one command of 54 digits, or two commands totaling 52 digits, or three commands totaling 50 digits, etc. If you run out of room, you may place the name of another macro into the macro being created. This increases the storage capacity to another 54 digits. The process may be repeated, thus chaining together a series of macros that will be executed together.

CAUTIONS

Do not create a macro that contains itself. In other words, macro 65* must not have 65* stored in it. Do not create a continuous ring of macros; that is, macro 65* should not call 66* if 66* can find a path back to 65* (perhaps via several other macros).

MACROS

MACRO EXECUTION

When a macro is executed, the individual commands within that macro are executed in the order they were stored. For example, if a macro contains three commands that send CW messages, then the messages will be sent in the order they appear in the macro. If this macro contains another macro, then the **nested** macro will be fully executed before the controller continues on with the remaining commands in the original macro.

LEADING ZEROES

Control commands that Create, Append, etc., require you to enter the macro name in four digits. If you wish to give the macro a shorter name, then you must enter leading zeroes. Thus, the names 5*, 05*, 005* and 0005* all refer to the same macro. When executing a macro, the leading zeroes are not needed. Therefore, simply entering 5* is sufficient to execute macro 0005*. When placing macros within other macros, the leading zeroes are not necessary.

USES FOR MACROS

You'll find many uses for macros. Here are some suggestions:

1. **Autodials:** Create macros that make autopatch calls, then append commands that send acknowledgements such as "Fred", "Police" or "Fire". For macros that call an emergency number, append a command that extends the autopatch timeout timer. Make your macros easy to remember, such as 911* or 2000*, or make them more secure with lettered DTMF digits in their names, such as 3AB7*. Create autodial numbers for your club members in exchange for an annual fee, thus providing extra club revenue.
2. **Restricted Autopatch:** Change the autopatch password to an unpublished 6-digit number. Create autodial macros only for permitted phone numbers. Release "public" macros to users. Rename private macros if they become public.
3. **User Features:** Create short macros that users will enjoy, such as 11* to send the time of day in CW, 22* to send the date, 33* to dump the autopatch, and 50* to energize a logic output that causes a tape cartridge machine to give the latest club announcements.

MACROS

APPEND TO MACRO

Command Form:	(PW) 29 (macro name, command) *							
Description:	This command is used to attach an additional command to a macro. The macro name must already exist in the directory. The stored information, shown above as "command," may be a control command or another macro name (if you wish to chain together several macros). Use a separate Append command for each command to be appended to a macro.							
Acknowledgement:	OK							
Errors:	<table><tr><td>? ERR 1</td><td>too few digits entered</td></tr><tr><td>? NOT FOUND</td><td>macro name does not exist in directory</td></tr><tr><td>? TOO BIG</td><td>command being entered exceeds the remaining storage area for this macro</td></tr></table>		? ERR 1	too few digits entered	? NOT FOUND	macro name does not exist in directory	? TOO BIG	command being entered exceeds the remaining storage area for this macro
? ERR 1	too few digits entered							
? NOT FOUND	macro name does not exist in directory							
? TOO BIG	command being entered exceeds the remaining storage area for this macro							
Examples:	Assume macro 6A was created to send the time of day, and now we want to add month and day announcement. The command to send the month and day is (PW) 14 3 *. To append this command to macro 6A, enter:							

(PW) 29 006A (PW) 14 3 *

Note that the macro 6A must exist before this additional command may be appended. See the Create New Macro command.

Additional commands may be appended to a macro until the storage space for that macro is used up. If more commands are needed than can fit into a single macro, then simply append the name of another macro to the original macro. This new macro is created and appended similarly to the original macro; if the new macro is filled, append another. This process can continue until the limit of 32 chained commands is reached.

NOTE: The acknowledgement message "OK" simply indicates that the Append to Macro command was entered correctly, and that the controller appended whatever digits it was given. It does not guarantee that the digits it stored represented an executable command. It is possible to store garbage digits in a macro just as easily as legitimate commands.

MACROS

CREATE NEW MACRO

Command Form: (PW) 20 (macro name, command) *

Description: This command is used to create a new macro. A new macro is a macro with a name that has not been used before. This command places the name of the new macro in a directory, then places the digits following the macro name into a storage area in memory. The digits that are stored in memory are shown above as "command". "Command" may be either a control command, or the name of another macro. If you are storing a control command, don't forget to include the control command's password. In other words, the "command" stored into a macro must be a complete, executable command or a macro.

Acknowledgement: OK

Errors:

? ERR 1	too few digits entered
? NAME USED	macro name already exists in the directory
? DIR FULL	directory is filled with the maximum number of macros
? TOO BIG	the command being entered for storage exceeds the storage area allowed for a macro

Default Condition: no macros exist

Examples: Assume that we wish to create a macro that sends the time of day. The control command would normally be (PW) 14 1 * for time-of-day in 12-hour format. Since we do not wish to disclose control command information to our users, we can simply put this command into a macro. Let's call the macro 6A (assume that our users have 16-button DTMF Keyboards). Enter:

(PW) 20 006A (PW) 14 1 *

Users may now request the time of day by entering 6A*. Note that the macro name is entered with leading zeros, since the name we chose is fewer than 4 digits long. Also, note that the command following the macro name is a complete command, including password!

If additional commands are to be executed by entering 6A, they can be appended. See the Append to Macro command.

Note that the acknowledgement message OK simply indicates that the Create New Macro command was entered correctly, and that the controller created a new directory entry with some digits stored in memory. It does not guarantee that the digits it stored represented an executable command. It is possible to store garbage digits in a macro just as easily as legitimate commands.

MACROS

ERASE MACRO

Command Form: (PW) 21 (macro name) *

Description: This command erases an existing macro. The macro name must be entered as 4 digits; if the name of the macro you are erasing has a shorter name, enter leading zeros.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? NOT FOUND macro name does not exist in the directory

Examples: Assume that a macro exists with the name 6A, and that it contains several commands. To erase this macro, enter:

(PW) 21 006A *

After the above command is entered, the entire macro 6A will no longer exist. The storage area used by this macro will be released, and another macro can be created to take its place. Macro name 6A, since it is now erased from the directory, can be used as the name of a new macro.

MACROS

ERASE ALL MACROS

Command Form: (PW) 22 00 *

Description: This command is used to erase all existing macros. **USE WITH CARE!!** If accidentally entered all macros will be lost! The zeroes in the command must be entered as a precaution to avoid accidents.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 zeroes were not entered

MACROS

LIST MACRO

Command Form: (PW) 33 (macro name) *

Description: This command is used to examine the contents of a macro. Entering the command causes the controller to send all stored digits in CW, with the “*” character sent as a fraction bar (/).

The macro name must be entered using 4 digits. If the macro you wish to list has a shorter name, enter leading zeros.

Acknowledgement: sends the contents of the macro in CW

Errors: ? ERR 1 wrong number of digits entered
 ? NOT FOUND macro name does not exist in the directory

Examples: Assume that a macro exists with the name 6A. It contains two commands: one sends the time of day in CW, and the other sends the day and date in CW. To make the example clearer, assume that the password is 99.

When the commands were originally placed into the macro, they looked like this:

(PW) 14 1 *, and
(PW) 14 3 *

To list this macro, we would enter:

(PW) 33 006A *

The controller would then send:

9 9 1 4 1 / 9 9 1 4 3 /

MACROS

RENAME MACRO

Command Form: (PW) 27 (old name, new name) *

Description: This command is used to change the name of an existing macro. The commands stored in the macro are not affected. The macro names must be entered using 4 digits. If either (or both) is shorter than 4 digits, enter leading zeroes.

Acknowledgement: OK

Errors:

? ERR 1	wrong number of digits entered
? NOT FOUND	the old name does not exist in the directory
? NAME USED	the new name already exists in the directory

Examples: Assume that a macro exists under the name 6A, and that we want to change its name to 1200. Enter the following command:

(PW) 27 006A 1200 *

Assume that we now want to change its name to 789. Enter the following command:

(PW) 27 1200 0789 *

Finally, let's change its name once more to simply D. Enter the following command:

(PW) 27 0789 000D *

Here is a wrap up of what we have done: Before its name was changed, the macro was executed by entering 6A*. After the first name change, it was executed by entering 1200*. After the second name change, it was executed by entering 789*. After the third name change, it was executed by entering D*. You can see that a macro can have a short or a long name, and that its name can be made up of numerals and letters.

POWER ON

EVENT-TRIGGERED MACRO

Command Form: (PW) 26 00 (macro name) *

Description: This command assigns a macro to be executed when the controller goes through a warm start up. Enter a 4-digit macro name, using leading zeroes if the macro name is less than 4 digits long. To delete the assignment, enter no macro name.

Acknowledgement: OK

Errors:
? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: no macro is assigned

Examples: This command is useful for initializing hardware at the repeater site following a power interruption. A macro can be created that momentarily switches on the logical outputs; this macro is then triggered by a restart.

The command has no effect after a cold restart, since all macros are deleted anyway.

As an example of how this command may be used, assume that macro 3456* has been created to change the CW frequency to a high pitch. To arrange triggering of this macro from a restart, enter:

(PW) 26 00 3456 *

If power at the repeater site should fail and return later, the controller will notify you since the CW pitch is now higher. You may enter a macro or a control command that changes the CW pitch back to normal, awaiting the next power "glitch".

SECURITY

INTRODUCTION

One of the security features used by the controller is a dual-password system.

There are two levels of command privileges. The operators holding the Master password are the higher-level group, since the Master password may be used with all control commands. The operators holding the Control Operator password are the lower level group, since their password only works with certain designated control commands. You may select the commands that are available to the Control Operators, which can range from none to all commands.

The Master password and Control Operator password may be 2, 4, or 6 digits long. The passwords may contain the numbers zero through nine, and the lettered keys A, B, C, and D.

SECURITY

CHANGE CONTROL OPERATOR PASSWORD

- Command Form:** (PW) 92 (new password) *
- Description:** This command assigns a new password for Control Operators. The new password may be 2, 4, or 6 digits in length, and may be any combination of the numbers 0 through 9 and the letters A through D.
- Acknowledgement:** OK
- Errors:** ? ERR 1 wrong number of digits entered
- Default Condition:** no password is assigned to Control Operators.
- Examples:** Assume that there is no Control Operator password, the default condition. To make the Control Operator password 95, enter:

(PW) 92 95 *

So, if the Master password is 2A3B4C, enter:

2A3B4C 92 95 *

SECURITY

CHANGE MASTER PASSWORD

Command Form: (PW) 93 (new password) *

Description: This command assigns a new Master password. The new password may be 2,4 or 6 digits in length, and may be any combination of numbers 0 through 9 and the letters A through D.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered

Default Condition: the password defaults to 99.

Examples: Assume that the present Master password is 99, the default password. To change it to 1234, enter this:

99 93 1234 *

The new password is 1234 at this time. To change it to 2A3B4C, enter this:

1234 93 2A3B4C *

SECURITY

ASSIGN PRIVILEGE LEVEL

Command Form: (PW) 94 (root no., level) *

Description: This command assigns a privilege level to a control command.

Enter the root number of the command, then 0 or 1:

0 = Command may be used by either password

1 = Command may be used only by the Master password

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: all commands may be accessed by either password

Examples: Assume the Control Operators have full privileges, the default condition. To prevent control operators from changing either the Master password or the Control Op password, enter the following:

(PW) 94 92 1 *

[Root 92 is the Control Op password command.]

(PW) 94 93 1 *

[Root 93 is the Master password command.]

The Privilege Level command allows Control Operators limited access to repeater functions. The password may be changed as often as desired.

REPEATER OPERATION

INTRODUCTION

There are a number of commands that control the repeater's operating characteristics, or "personality". We will define here the terms used in these commands.

COURTESY TIMER & MESSAGE

When a transmitting station unkeys his/her microphone, the Courtesy Timer starts. When this timer expires, the Courtesy Message is sent. At the same time, the repeater Timeout Timer is reset. The purpose of the courtesy message is to inform the next station that he may now transmit for the full duration of the timeout timer. The courtesy timer encourages stations to allow a short break in their transmissions, allowing other stations to break in.

DROPOUT TIMER AND MESSAGE

After the courtesy timer expires, the Dropout Timer starts. When this timer expires, the Dropout Message is sent and the repeater transmitter drops.

TIMEOUT TIMER AND MESSAGE

If a station transmits for a period longer than the Timeout timer is set for, the Timeout Message will be sent and the repeater transmitter will drop. If a station can override the offending station and enter the Reset Timeout timer command, the transmitter will return to the air and the timer will be reset. When the offending station releases his/her push-to-talk button (and no one has reset the timer for them), the Timeout Message will be sent again to inform them that part of their transmission may have been lost.

All three timers and all three messages are fully programmable. If, for example, you don't want any courtesy delay or courtesy message, you may delete both. In this case, the Timeout Timer will reset immediately upon the user dropping his carrier.

REPEATER OPERATION

ACCESS MODE

Command Form: (PW) 57 00 (mode 0-5) *

Description: This command selects one of six possible repeater access modes:

Mode 0 No Access. Activity on the COR and PL inputs is ignored.

Mode 1 Carrier Access. Activity on the COR input will key the transmitter. Activity on the PL input is ignored.

Mode 2 PL Access. Activity on the PL input will key the transmitter. Activity on the COR input is ignored.

Mode 3 AND-PL access. Activity on both the COR and PL inputs simultaneously will key the transmitter.

Mode 4 OR-PL Access. Activity on either the COR or PL inputs will key the transmitter.

Mode 5 ANTI-PL Access. Activity on the COR input simultaneously with no activity on the PL input will key the transmitter.

Note: Repeater Access may be made different from DTMF Decoder access.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: Mode 1 (Carrier Access)

Examples: If the repeater is in carrier access mode, and PL access is desired, enter:

(PW) 57 00 2 *

A better mode for many repeater installations is Mode 3, AND-PL Access. (This mode has better rejection of adjacent-channel interference than Mode 2, since noise falsing from unsquelched audio is eliminated. Also, COR drops out more quickly than PL, allowing a quick dropout result. Enter:

(PW) 57 00 3 *

Mode 4 allows both carrier access and PL operation. Since PL is more easily detected, PL users will find increased range. Carrier access users are unaffected. The squelch may be tightened to suppress band-opening problems. ANTI-PL is used when the repeater is co-channel with another, PL-accessed repeater. Users of the second system are kept out of the ANTI-PL system. If you rebroadcast Westlink, the NO ACCESS mode means that transmissions on the repeater input are ignored and can't interfere with the broadcast. If you need to control the system on its input, place the DTMF decoder in a PL mode.

REPEATER OPERATION

RECEIVER #2-TO-TRANSMITTER PATH

Command Form: (PW) 63 82 (0=off/1=on) *

Description: This command determines whether Receiver #2 will be used as a link receiver or as a control receiver.

If the Receiver #2-to-Transmitter Path is turned on, then Receiver #2 will act as a link receiver. This means that Receiver #2 will drive the repeater transmitter and the DTMF decoder, but on a low priority basis.

If the Receiver #2-to-Transmitter Path is turned off, then Receiver #2 will act as a control receiver. This means that Receiver #2 will not drive the repeater transmitter, but it will drive the DTMF decoder as its highest-priority source.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: off Receiver #2 acts as a Control Receiver

REPEATER OPERATION

COURTESY TIMER

Command Form: (PW) 32 (0.0 - 5.0 seconds)

Description: This command programs the courtesy time. The courtesy time is the delay from the COR drop to the timer reset (and courtesy message). Enter two digits from 00 to 50 representing a delay from 0.0 to 5.0 seconds.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 0.5 seconds

Examples: A generous amount of courtesy time forces repeater users to delay their transmissions, thus allowing other stations to break into the conversation. This is something referred to as an anti-tailgating measure. A station that ignores the courtesy message (indicating that the timeout timer has been reset) runs the risk of timing out the repeater. He will have to repeat the portion of this transmission that was lost.

To program the courtesy timer for 1.4 seconds, for example, enter:

(PW) 32 14 *

Some repeater groups prefer no courtesy time; that is, the timeout timer resets as soon as the COR drops. The courtesy message may also be erased.

To program the courtesy timer for zero delay, enter:

(PW) 32 00 *

REPEATER OPERATION

DROPOUT TIMER

Command Form: (PW) 30 (0.0 - 5.0 seconds) *

Description: This command programs the dropout timer. The dropout time is the delay from the end of the courtesy timer/courtesy message (and timeout timer reset) to the moment the repeater transmitter drops. Enter two digits from 00 to 50 representing a delay from 0.0 to 5.0 seconds.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 3.0 seconds

Examples: Owners of tube-type repeater sometimes use long dropout timer to lengthen the lives of tubes and relays. Fewer transmitter keying transitions occur, since the users will keep the transmitter up for the duration of the conversation. The dropout time for solid-state repeaters is mostly up to personal preference.

To program the dropout timer for 2.1 seconds, for example, enter:

(PW) 30 21 *

To program the dropout timer for minimum time, enter:

(PW) 30 00 *

REPEATER OPERATION

TIMEOUT TIMER

Command Form: (PW) 40 (.1 - 54.6 min/000 = infinity) *

Description: This command controls the maximum amount of time that an input carrier signal may be present. The timeout timer starts timing when the COR becomes active, and continues to run until reset. The timeout timer is reset either by command or by releasing the carrier signal until the courtesy time elapses.

Enter one, two, or three digits from 1 to 546 to set the timeout timer to 0.1 to 54.6 minutes. To disable the timer completely, enter three zeroes.

Acknowledge: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: 3.0 minutes

Examples: To change the timeout timer from its existing value to 4.5 minutes, enter:

(PW) 40 45 *

To change the timeout timer to 10.0 minutes, enter:

(PW) 40 100 *

To set the timer for infinity (no timeout), enter:

(PW) 40 000 *

Remember, the amount of time entered is in minutes and tenths of minutes. Therefore, entering (PW) 40 3 * will set the timer to 0.3 minutes (18 seconds). If you want 3.0 minutes, be sure to enter (PW) 40 30 *.

Leading zeroes are permitted. Therefore, entering

(PW) 40 30 *

is the same as entering

(PW) 40 030 *

REPEATER OPERATION

TIMEOUT TIMER RESET

Command Form: (PW) 10 *

Description: This command resets the timeout timer. If the timeout timer has been exceeded, this command will allow the conversation to continue.

Acknowledgement: none

Errors: none

Examples: If the transmitting station caused a timeout to occur, the receiving station may be able to bring the repeater back up. It would require the receiving station to be able to override the offending station at the repeater site.

Entering this command will reload the timer as well as return the repeater transmitter to the air.

REPEATER OPERATION

ACTIVITY MONITOR (Activity-Triggered Macros)

Command Form:	Start-of-Activity Macro Post-Activity Macro Activity Counter/Timer	(PW) 26 14 (macro name) * (PW) 26 15 (macro name) * (PW) 45 (event 0-9, 0.0 - 9.9 min delay) *
----------------------	--	--

Description: These commands allow you to execute macros based on the activity of the repeater. For example, a bulletin may be sent a few minutes after the last activity of the repeater; since the repeater was recently used, chances are there is an audience to hear the message. If sending the bulletin after every conversation is too repetitious, use the activity counter to select how often to send it.

The Start of Activity Macro is executed when a fresh key-up occurs. This event starts an "activity cycle" which ends a certain time after the tail finishes. If activity occurs before the timer expires, the activity cycle is simply extended. When the timer finally expires, the Post-Activity macro is executed. The post-activity timer is programmable in duration from zero to 9.9 minutes. The activity counter, which watches the number of activity cycles, may be programmed from zero to 9 events.

Once the activity cycle has been completed, the Start of Activity Macro is again "armed" and ready to execute at the next key-up activity. This is true whether or not the last post-activity macro was actually executed. It may have been waiting for the proper activity count.

Applications for this feature include tape recording all repeater conversations, in which case the activity count would be set to zero. However, if a taped message is to be played every fifth usage of the repeater, set the activity counter to 5.

NOTE: The Post-Activity Counter works as follows:

Setting the counter to 0 (zero) means that the Post-Activity Macro will execute at each activity cycle. Setting the counter to 1 means that the Post-Activity Macro will execute every other activity cycle, and so on. Setting the counter to 9, therefore, means that the Post-Activity Macro will execute every 10th cycle. Also note that the Activity Timer starts when the Dropout Message is sent.

TRANSMITTER

TRANSMITTER ENABLE/DISABLE

Command Form: (PW) 63 00 (0 = disable/1 = enable) *

Description: This command is used to enable or disable the repeater transmitter. It does not affect any repeater receiver functions. The receiver will still be able to send commands to the controller, but the transmitter will not key. When the transmitter is disabled, the controller will not key it under any conditions.

Acknowledgement: OK (enable only)

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: enabled

TRANSMITTER

TRANSMITTER KEY

Command Form: (PW) 00 (1-546/000 = infinity/(nothing) = cancel) *

Description: This command simply keys the repeater transmitter. The keying duration may be either timed or untimed (untimed means stay keyed until cancelled by command). For timed key, enter one, two, or three data digits in the range of 1 to 546, representing 0.1 - 54.6 minutes. For untimed key, enter three zeros (000) to key indefinitely. To cancel the key request, enter no data digits after the root number.

The transmitter will not key if it has been disabled by the Transmitter Enable/Disable command.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 illegal digit entered

Default Condition: transmitter is not requested to key.

UTILITIES

COMMAND RESPONSES

Command Form: (PW) 63 02 (0 = off/1 = on) *

Description: This command turns the CW response messages on or off.

Acknowledgement: OK (if turning on)

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: on

Examples: Command Responses are the CW messages that are sent to assist the programmer. Most commands send OK when properly entered, although some send back the actual message that was entered. Other responses include error messages that indicate bad data or incorrect number of keystrokes.

When commands are placed into macros, command response messages may be undesirable. To turn them off, enter:

(PW) 63 02 0 *

To turn back on, enter:

(PW) 63 02 1 *

NOTE: If Command Response is turned OFF, then ALL CW command acknowledgements and error messages will NOT be sent.

UTILITIES

COMMAND TERMINATION FOR REPEATER RECEIVER

Command Form: (PW) 99 (00 = */0.1 - 9.9 sec) *

Description: This command allows users to terminate commands entered via the repeater receiver (RX1) by releasing the PTT button (COR drop). If not allowed, then the star "*" character is required to terminate a command. Whether or not the carrier drop method is enabled, the * character can always be used to terminate a command.

If the COR drop method is desired, enter two data digits in the range 01 to 99, representing 0.1 to 9.9 seconds. This is the amount of time after the COR drop is sensed that the command will be executed. To disable the COR drop method, thereby requiring the * character for command termination, enter two zeros (00).

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
? ERR 2 illegal digit entered

Default Condition: * character required to terminate commands.

Examples: To turn on the carrier-drop termination feature and set the delay to 1.0 seconds, enter:

(PW) 99 10 *

Remember, the * character can still be used to terminate a command. This is important if weak signals are holding the COR up.

Some delay is needed for this feature to work properly; without it, a momentary loss of carrier could terminate a command before it's completely entered. But delays greater than a few seconds are not practical, because the incoming command must be terminated before the DTMF Interdigit Timer expires. And, since some user transmitters don't drop quickly after the last DTMF character, more time elapses before the carrier drops.

UTILITIES

COMMAND TERMINATION FOR CONTROL RECEIVER

Command Form: (PW) 56 (00 = */0.1 - 9.9 sec) *

Description: This command allows users to terminate commands entered via the control receiver (RX2) by releasing the PTT button (COR drop). If not allowed, then the star "*" character is required to terminate a command. Whether or not the carrier drop method is enabled, the * character can always be used to terminate a command.

If the COR drop method is desired, enter two data digits in the range 01 to 99, representing 0.1 - 9.9 seconds. This is the amount of time after COR drop is sensed that the command will be executed. To disable the COR drop method, thereby requiring the * character for command termination, enter two zeros (00).

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered

Default Condition: * character required to terminate all commands.

Examples: To turn on the carrier-drop termination feature and set the delay to 1.0 seconds, enter:

(PW) 56 10 *

Remember, the * character can still be used to terminate a command. This is important if weak signals are holding up the COR.

Some delay is needed for this feature to work properly; without it, a momentary loss of carrier could terminate a command before it's completely entered. But delays greater than a few seconds are not practical, because the incoming command must be terminated before the DTMF Interdigit Timer expires. And, since some user transmitters don't drop quickly after the last DTMF character, more time elapses before the carrier drops.

UTILITIES

PAUSE

Command Form: (PW) 98 (1 - 255 seconds) *

Description: This command causes the controller to stop the execution of the commands that follow for the programmed amount of time. This causes a delay to occur between commands.

Acknowledgement: none

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 illegal digit entered

Default Condition: no pause

Examples: To delay command execution 2 seconds, enter:

(PW) 98 2 *

To delay command execution 10 seconds, enter:

(PW) 98 10 *

Very long delays are not recommended, as the controller will not execute additional DTMF commands that it receives during the delay. However, pause commands can be used very effectively when placed into macros between other commands.

UTILITIES

COR PULSE-TRIGGERED MACRO

Command Form: Select Macro (PW) 26 17 (macro name) *
Select Parameters (PW) 47 (0, count, width, window) *

Description: The controller can execute a macro when a user clicks his PTT button several times in succession. Two commands are used to set up this feature: one command selects the macro to be executed; the other selects the parameters of the pulse string.

"Macro Name" is the macro to be executed.

"Count" means Pulse Count. It is the number of pulses that occur within the Width and Window parameters to trigger execution of the macro. The range is 0 to 9 pulses.

"Width" means the Minimum Duration of a pulse to be considered valid, and is measured in 10 mS increments. The range is 0001 to 9999, or 00.01 seconds (10 mS) to 99.99 seconds (99,990 mS). By requiring a certain minimum pulse width, the controller can discriminate against narrow noise pulses. Use four digits.

"Window" means the overall time allowed for the pulses to be counted, and is measured in 10 mS increments. The range is 0001 to 9999, or 00.01 seconds (10 mS) to 99.99 seconds (99,990 mS). Use four digits.

Acknowledgement: OK

Errors: ? ERR 1 wrong number of digits entered
 ? ERR 2 illegal digit; conflict in parameters

Default Condition: Macro Name = (none)
Pulse Minimum Width = 0050 = 0.5 seconds
Window = 0500 = 5.0 seconds

How it Works: The window timing cycle starts at the leading edge of the first pulse. If the pulse lasts longer than the minimum width programmed, it is counted. If the correct number of pulses is counted before the window "closes," the programmed macro will be executed on the falling edge of the last counted pulse.

The controller calculates a maximum pulse duration time and a maximum dead zone (the time between pulses) when you program the parameters. During a window timing cycle, the controller is timing the pulses and the dead zones. The window cycle will be aborted if the inter-pulse dead zone exceeds the maximum value; if any pulse exceeds the maximum value; and if any pulse is less than the minimum width. This means that a new window

cycle can begin as soon as the old one is either properly executed or is discarded for any reason.

The signals required for a pulse depend upon the repeater access mode. If the repeater is in Carrier Access Mode, then the controller will count pulses at the COR input. If the repeater is in AND-PL Access Mode, then the controller will count pulses that are made up of both COR and PL signals.

Examples: Execute macro "123" when four pulses are received. Each pulse must be 1/4 second long, and all four pulses must occur within 5 seconds. The commands are:

(PW) 26 17 0123 *, which assigns macro "123"
(PW) 47 0 4 0025 0500 *, which assigns parameters

NOTE: "0025" x 10 mS = 250 mS = 1/4 second, and "0500" x 10 mS = 5000 mS = 5 seconds.

The controller calculates that 4 pulses at 1/4 second each equals one second pulse time. The maximum dead zone is then 4 seconds, and no pulse can exceed 4 1/4 seconds. The window will close if any of these timers are exceeded.

The controller will respond with an error if the pulse count, multiplied by the width, exceeds the window time.

HISTORY OF 6K SOFTWARE CHANGES

V1.00

Version 1.00 was the first software release for the 6K, and was shipped with controller serial numbers 101 through 111.

V1.01

Version 1.01 added the ability to invert the TX PTT output via dipswitch 5. This version was shipped with controller serial numbers 112 through 132.

V1.02

Version 1.02 added the Access Autopatch Without Password feature. This feature was added to all controllers with serial numbers 133 and greater.

V2.0, V2.1

Version 2 was a major upgrade that added a number of new features to the 6K. Documentation for Version 2 may be found at the end of this manual.

INSTALLING THE S-COM 5K REPEATER CONTROLLER IN A SPECTRUM COMMUNICATIONS SCR 77 FM REPEATER

1. Locate the **PRC77 Power Supply/COR/AF Mixer Board**. Cut one end of resistors R305, R341, and R342. (Cutting R305 inhibits PRC77 control of PTT; cutting R341 and R342 opens the CW ID audio and the RX-to-TX audio paths, respectively.)
2. **Receiver Audio:** Connect the "RX AUDIO" input of the 5K (pin 13) to terminal 3 (the high side) of R601, the 50K Monitor volume pot mounted on the front panel of the repeater. This point furnishes high-level, flat audio that has the CTCSS tone filtered out. If the repeater does not have the optional CTCSS board, then the same audio can be found at terminal E1105 on the receiver module, and at pin 2 of accessory connector J601.
3. **Transmitter Audio:** Connect the "TX AUDIO" output of the 5K (pin 11) to pin 1 of the accessory connector J601. Pot R343 on the PRC77 board controls the level of this audio before being sent to the transmitter.
4. **Receiver COR:** Connect the "RPTR RX COR" input of the 5K (pin 6) to pin 4 of U302 on the PRC77 board. The easiest way to accomplish this is to solder to the end of R321 nearest U302. The voltage at this point will go high when a carrier is present; therefore, set the "RX" dip switch on the 5K board to the OFF position.
5. **Transmitter PTT:** connect the "TX PTT" output of the 5K (pin 10) to terminal E1205 on the transmitter module. Since the 5K must provide a logic low level to this terminal to key the transmitter, set the "TX" dip switch on the 5K board to the ON position.
6. **Ground:** connect any of the GROUND pins of the 5K (pins 14 thru 25) to pin 9 of accessory connector J601.

This completes basic installation requirements. Local microphone operation is retained.

If no control receiver is to be used with the 5K, be sure that the 5K's "CT" dipswitch remains in the ON position.

INSTALLING THE S-COM 5K REPEATER CONTROLLER IN A SPECTRUM COMMUNICATIONS SCR1000 FM REPEATER

1. Locate the **ID100 ID & Audio Mixer Board**. Cut the wire that connects terminals E509 and E525. This eliminates the CW tone from the old ID'er to the transmitter.
2. Locate the **CTC100 COR/Timer/Control Board**. Clip one end of resistor R20. This prevents the CTC100's timers from controlling the repeater.
3. Locate the 8-pin jack, J602. Cut the jumper that connects pins 1 and 2. This eliminates the repeater's internal receiver-to-transmitter audio path.
4. Prepare a cable to connect J602 of the Spectrum repeater to the DB25 connector on the S-COM 5K controller. Five signals are required, listed below:

Transmitter Audio: Connect the "TX AUDIO" output of the 5K (pin 11) to pin 1 of J602. This is the repeater's A.F. Input.

Receiver Audio: Connect the "RPTR RX AUDIO" input of the 5K (pin 13) to pin 2 of J602. This is the repeater's A.F. Output.

Transmitter PTT: Connect the "TX PTT" output of the 5K (pin 10) to pin 4 of J602. This is the repeater's AUX PTT input. Since the SCR1000 requires a low-true signal to key the transmitter, set the TX dipswitch in the 5K to the ON position.

Receiver COR: Connect the "RPTR RX COR" input of the 5K (pin 6) to pin 5 of J602. This is the repeater's AUX COR output. Since the SCR1000 pulls pin 5 low when an incoming signal is present, set the RX dipswitch in the 5K to the ON position.

Ground: Connect any of the ground pins of the 5K (pins 14 thru 25) to pin 8 of J602. This is the repeater's CHASSIS GROUND connection. Since good practice dictates the use of shielded cable for audio connections, the shield can be used for this ground connection.

5. Prepare a cable to connect J603 of the Spectrum repeater to the 2.5-mm power plug supplied with the 5K. Connect the +13.8 VDC output of the repeater, pin 3 of J603, to the inside receptacle of the power plug. Connect the ground of the repeater, pin 7 of J603, to the outside sleeve of the power plug.

INSTALLING THE S-COM 5K REPEATER CONTROLLER IN A G.E. CUSTOM MVP REPEATER

1. NOTE: These instructions were prepared from the G.E. Custom MVP Maintenance Manual (LBI30163-G).
2. Refer to the "System Audio-Squelch Board" section of the manual. The G.E. part number of this board is 19C321920G1. The schematic is found on page 9.
3. Receiver Audio: Prepare a length of shielded audio cable. Connect the inner conductor of one end to the "hot" end of R922 (2K ohms). The "hot" end of R922 is the junction of R922, C912, C931, and pin 8 of audio amp AR901. Connect the shield to the other end of R922 (ground). The other end of the cable goes to the 5K controller: Connect the inner conductor to pin 13 (RX AUDIO). Connect the shield to pin 25 (GROUND). The volume pot will affect repeat level.
4. Repeater Receiver COR: Locate transistor Q903 (labeled "RX Mute") on the G.E. board. Connect a wire from its collector to a 100K resistor. Connect a 47K resistor from the free end of the 100K to ground. Connect a 2N3904 (or similar) NPN transistor as follows: Base to the junction of the 47K and 100K; emitter to ground; and collector to a piece of wire. Connect the other end of the wire to pin 6 of the 5K (RPT RX COR). (If you are shielding this wire, the nearest 5K ground pin is 17).
5. Transmitter Audio: Locate the connection labeled J913 MIC HI (it's found in the lower right-hand corner of the schematic). Connect the positive (+) end of a 2.2-uF capacitor to J913. Connect the other end of the capacitor to the inner conductor of a length of shielded cable. Connect the shield of the cable to ground. The other end of the cable goes to the 5K: Connect the inner conductor to pin 11 (TX AUDIO). Connect the shield to pin 22 (GROUND).
6. Transmitter PTT: Locate the connection labeled J911 PTT (next to J913 from step 5 above). Or, you can use connection H17 if it's more convenient. Connect a wire from this point to pin 10 of the 5K (TX PTT). (If you are shielding this wire, the nearest 5K ground pin is 21).

Remember, pins 14 through 25 of the 5K's connector are all grounded for convenience in hooking up cable shields.

USING THE S-COM 5K AS A BEACON CONTROLLER

Several customers are using the S-COM 5K Repeater Controller as a beacon controller. The 5K does an excellent job at this, since the speed, pitch, and interval of the ID'er is remotely programmable; it can also be turned on and off remotely. Here's how to do it:

1. Program the repeater Timeout Timer for infinity.
2. Program the ID Interval for the desired frequency of occurrence (perhaps 1.0 minutes).
3. Either ground the COR input ("RX" switch is ON), or open the COR input ("RX" switch is OFF).

The transmitter will stay keyed indefinitely. The ID will be sent at the interval selected by command.

If desired, the 5K can change the actual ID message automatically. This is accomplished by using the ID-triggered-macro capability: When the controller wishes to ID, it executes a macro. The macro sends the CW ID, and also changes the ID-triggered-macro for the next ID.

For example, let's assume that we have defined 5 CW ID messages that we want the 5K to "rotate". How do we program the 5K to do the rotation?

First, delete the callsigns that have been stored in the ID'er, if any. Second, create five macros. Let's call them 1100, 1101, 1102, 1103 and 1104. Place two commands into each macro; the first one is a "Send CW Message" command that has one of the desired callsigns in it, and the second one reprograms the Impolite ID macro:

(PW) 20 1100 (PW) 15 (CW message #1) *
(PW) 29 1100 (PW) 26 05 1101 *

(PW) 20 1101 (PW) 15 (CW message #2) *
(PW) 29 1101 (PW) 26 05 1102 *

Continue building macros 1102, 1103 and 1104. Macro 1104 reprograms the Impolite ID macro back to 1100:

(PW) 20 1104 (PW) 15 (CW message #5) *
(PW) 29 1104 (PW) 26 05 1100 *

Don't forget to program the Impolite ID macro to get the chain started:

(PW) 26 05 1100 *

You'll also want to suppress command CW responses to keep from hearing "OK" each time a macro is executed.

6K REPEATER CONTROLLER MAIN BOARD PARTS LIST

RESISTORS

237	ohms 1% 1/4W	1	R21
604	ohms 1% 1/4W	1	R63
1.69K	ohms 1% 1/4W	1	R22
11.3K	ohms 1% 1/4W	1	R73
14.0K	ohms 1% 1/4W	1	R72
22.6K	ohms 1% 1/4W	2	R38,R39
47	ohms 5% 1/4W	6	R33,R43,R50,R61,R84,R85
100	ohms 5% 1/4W	2	R67,R74
1K	ohms 5% 1/4W	2	R30,R44
4.7K	ohms 5% 1/4W	8	R13,R14,R15,R16,R17,R18,R19,R34
10K	ohms 5% 1/4W	8	R20,R29,R36,R37,R42,R52,R62,R87
20K	ohms 5% 1/4W	22	R23,R26,R40,R41,R45,R46,R47,R48, R49,R51,R53,R54,R55,R56,R57,R64, R65,R66,R69,R71,R83,R86
22K	ohms 5% 1/4W	1	R5
27K	ohms 5% 1/4W	1	R59
47K	ohms 5% 1/4W	2	R6,R35
51K	ohms 5% 1/4W	1	R9
68K	ohms 5% 1/4W	2	R60,R68
82K	ohms 5% 1/4W	1	R58
100K	ohms 5% 1/4W	5	R24,R27,R31,R32,R70
200K	ohms 5% 1/4W	2	R25,R28
300K	ohms 5% 1/4W	1	R7
4.7K 8-pin SIP network		3	R1,R8,R12
4.7K 10-pin SIP network		4	R2,R3,R4,R10
10K 14-pin DIP network		1	R11
50K pot		8	R75,R76,R77,R78,R79,R80,R81,R82

CAPACITORS

18	pF NPO ceramic	2	C2,C3
47	pF NPO ceramic	2	C45,C48
100	pF ceramic	14	C23,C24,C25,C26,C27,C28,C29,C34 C35,C36,C37,C43,C46,C72
470	pF NPO ceramic	1	C69
.001	uF film	4	C16,C38,C56,C57
.0022	uF film	1	C17
.0039	uF film	1	C55
.1	uF MLC	20	C1,C4,C5,C6,C7,C8,C9,C10,C11, C12,C13,C14,C15,C19,C21,C22,C30, C31,C32,C33
.1	uF film	1	C20
.47	uF film	12	C18,C44,C47,C50,C53,C61,C62,C63, C64,C68,C73,C74
1	uF tantalum	3	C40,C41,C58

4.7	uF tantalum	2	C60,C67
10	uF tantalum	11	C42,C49,C51,C52,C54,C59,C65,C66, C70,C71,C75
330	uF 25V electrolytic	2	C39,C76

DIODES

1N4002	2	D6,D7
ICTE-15/MPTE-15	1	D5
SA40A	4	D1,D2,D3,D4

TRANSISTORS

2N7000/VN10KM power MOSFET	3	Q4,Q5,Q6
MPQ3904 transistor array	2	Q1,Q2
RFP12N08L power MOSFET	1	Q3

INTEGRATED CIRCUITS

27C256 (programmed)	1	U5
74C906	1	U18
74HC00	1	U9
74HC04	1	U10
74HC138	2	U7,U8
74HC139	1	U6
74HC251	2	U14,U15
74HC259	2	U16,U17
74HC374	1	U19
74HC4078	1	U11
CA3080	1	U25
DS1210	1	U3
DS1232	1	U1
HD6340	1	U12
HD63B09	1	U2
HM62256LP	1	U4
LM317	1	U20
LM7805	1	U21
LMC660	3	U22,U23,U24
MF6CN-50	1	U26
MT8812	1	U27
MT8880	1	U13

CRYSTALS

3.579 MHz, case grounded	1	Y2
4.000 MHz, case grounded	1	Y1

BATTERY

3V lithium BR2325 1 B1

SWITCHES

Dip Switch, 6 pole	1	S2
Pushbutton, momentary	1	S1

FERRITE BEAD

2943666661 1 L1

CONNECTORS

2-pin male header	2	P3(MEM),P7(PWR)
4-pin male header	2	P1(RX1/ADM1),P2(RX2/ADM2)
10-pin male header	1	P5(DISP)
14-pin male header	1	P4(TIM)
2.5mm DC power jack	1	J1
DB25S PC mount	1	J2
8-pin IC socket	3	for U1,U3,U25
14-pin IC socket	10	for Q1,Q2,U9,U10,U11,U18,U22, U23,U24,U26
16-pin IC socket	7	U6,U7,U8,U14,U15,U16,U17
20-pin IC socket	2	U13,U19
28-pin IC socket	3	U4,U5,U12
40-pin IC socket	2	U2,U27

HARDWARE

PC Board	1	
Heat Sink	2	for U20,U21
4-40 x 3/8" machine screw	2	
4-40 hex nut	2	
#4 int tooth lockwasher	2	
6-32 x 1/4" machine screw	1	
6-32 hex nut	1	

**TELEPHONE INTERFACE MODULE
PARTS LIST**

RESISTORS

1.00K	ohms 1% 1/4W	2	R31,R50
3.01K	ohms 1% 1/4W	1	R49
10.0K	ohms 1% 1/4W	6	R2,R3,R8,R10,R15,R21
18.2K	ohms 1% 1/4W	1	R18
20.0K	ohms 1% 1/4W	5	R5,R9,R40,R46,R47
24.9K	ohms 1% 1/4W	1	R22
49.9K	ohms 1% 1/4W	4	R4,R37,R42,R48
22	ohms 5% 1/4W	1	R14
22	ohms 5% 1/2W	2	R52,R53
47	ohms 5% 1/4W	2	R1,R17
100	ohms 5% 1/4W	5	R6,R11,R12,R16,R30
620	ohms 5% 1/4W	1	R23
1K	ohms 5% 1/4W	8	R28,R32,R35,R38,R43,R51,R55,R56
1.5K	ohms 5% 1/4W	1	R29
2.2K	ohms 5% 1/4W	1	R54
2.7K	ohms 5% 1/4W	1	R26
10K	ohms 5% 1/4W	2	R27,R39
20K	ohms 5% 1/4W	2	R34,R45
47K	ohms 5% 1/4W	8	R7,R13,R19,R24,R33,R36,R41,R44
62K	ohms 5% 1/4W	1	R20
240K	ohms 5% 1/4W	1	R25

CAPACITORS

.001	uF film	2	C14,C19
.0047	uF film	1	C1
.01	uF film	1	C15
.022	uF film	1	C4
.1	uF film	2	C2,C17
.47	uF film	4	C6,C11,C13,C25
.47	uF 250V met poly	1	C30
2.2	uF tantalum	1	C18
4.7	uF tantalum	13	C3,C5,C7,C8,C9,C20,C21,C22,C23,C24, C26,C27,C28
10	uF tantalum	2	C10,C16
10	uF 50V elect	1	C29
22	uF 25V elect	1	C12

DIODES

1N4002		2	D5,D6
1N4732 4.7V		4	D1,D2,D4,D12
1N4735 6.2V		1	D7
1N914		5	D3,D8,D9,D10,D11
ICTE-15/MPTE-15		1	M1

TRANSISTORS

2N3904	2	Q2,Q3
2N3906	1	Q1

INTEGRATED CIRCUITS

CD4053	1	U2
CLM6500	2	VR1,VR2
ICM7555	1	U4
LCA110/LH1056	1	U5
LMC660/TLC274	2	U1,U3
TCM1520A	1	U7
TIL181	1	U6

GAS DISCHARGE TUBES

DSA301LS-270	3	E1,E2,E3
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TRANSFORMERS

SPT-109	1	T1
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FERRITE BEADS

2943666661	2	L1,L2
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HARDWARE

PC Board	1	
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CONNECTORS

14-pin (dual 7) header	1	J1
Ribbon Cable ass'y	1	-
Modular Jack 66011-001	1	J2
6-pin IC socket	2	(for U5,U6)
8-pin IC socket	2	(for U4,U7)
14-pin IC socket	2	(for U1,U3)
16-pin IC socket	1	(for U2)

AUDIO DELAY MODULE PARTS LIST

RESISTORS

4.99K	ohms 1% 1/4W	1	R30
11.3K	ohms 1% 1/4W	1	R13
14.0K	ohms 1% 1/4W	1	R14
20.0K	ohms 1% 1/4W	8	R3,R4,R5,R7,R8,R9,R10,R11
47	ohms 5% 1/4W	4	R15,R21,R26,R31
100	ohms 5% 1/4W	1	R16
120	ohms 5% 1/4W	1	R32*
2.7K	ohms 5% 1/4W	2	R27,R28
10K	ohms 5% 1/4W	6	R1,R12,R17,R20,R22,R25
100K	ohms 5% 1/4W	4	R2,R6,R18,R23
20K	ohms pot	1	R29
100K	ohms pot	2	R19,R24

CAPACITORS

100	pF ceramic NPO	2	C5,C9
.001	uF film	2	C11,C24
.0039	uF film	1	C7
.0047	uF film	1	C3
.039	uF film	2	C4,C8
.1	uF film	4	C16,C18,C20,C22
.47	uF film	6	C2,C6,C10,C17,C21,C25*
10	uF tantalum	7	C1,C12,C13,C14,C15,C19,C23

DIODES

1N961B 10V 400mW zener	1	D1*
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INTEGRATED CIRCUITS

7555 CMOS timer	1	U4
LMC660 CMOS op amp	1	U1
RD5108A delay	2	U2,U3

CONNECTORS

4-pin male header, .025" post	1	P1
8-pin IC sockets for U2 & U3	2	

MISC.

PC Board	1	
Ribbon cable assembly	1	

- * Model ADM/U (Universal) uses marked components.
Model ADM/K (for the 5K, 6K, and 7K repeater controllers) omits R32, C25 & D1; R32 and C25 are replaced by wire jumpers.

**S-COM 6K REPEATER CONTROLLER
SHORT FORM COMMAND LIST V1.02**

(PW) = password

AUTOPATCH

Access (with password)	(autopatch access password)(phone number)*
Access (without password)	(phone number)*
Access Without Password	(PW) 63 11 (0=disabled/1=enabled)*
Access Password	(PW) 23 (new autopatch access password)*
Access-Triggered Macro	(PW) 26 12 (macro name)*
Call Counter:	
Clear Counter	(PW) 69*
Send Count	(PW) 86*
Call Types	(PW) 60 (list 0-7/(none)=off)*
Clear Redialer	(PW) 85*
Dialing Message	(PW) 31 40 (message)*
Dialing Message Review	(PW) 34 40*
Dialing Mode	(PW) 61 (1 = 10pps/2=20pps/3=DTMF)*
Dialing Options	(PW) 63 04 (0=off/1=on)*
Dump	(PW) 83*
Dump-Triggered Macro	(PW) 26 13 (macro name)*
Full Duplex	(PW) 63 07 (0=off/1=on)*
Pound Down (# Dump)	(PW) 63 05 (0=off/1=on)*
Privacy	(PW) 63 06 (0=off/1=on)*
Redial	(PW) 84*
Repeater-to-Phone DTMF Mute	(PW) 63 08 (0=off/1=on)*
Restrictions, Accept:	
Clear Accept Table	(PW) 68*
Enter an Accepted Number	(PW) 68 (phone number)*
Restrictions, Reject:	
Clear Reject Table	(PW) 67*
Enter a Rejected Number	(PW) 67 (phone number)*
Reverse Patch:	
Answer	(PW) 88*
Trigger	(PW) 87*
Ringout Message	(PW) 31 51 (message)*
Ringout Message Review	(PW) 34 51*
Timeout Timer:	
Reset Timer	(PW) 81*
Time Limit	(PW) 65 (.1-54.6 min/000=infinity)*
Warning Message	(PW) 31 41 (message)*
Warning Message Review	(PW) 34 41*

CLOCK

Correction	(PW) 19 (00-59 sec per day, 0=slower/1=faster)*
Send Time	(PW) 14 (1=12 hour/2=24 hour/3=date)*
Set Time and Date	(PW) 18 (hours,minutes,month,day)*

CW

Disable/Enable	(PW) 63 01 (0=disabled/1=enabled)*
Frequency of Beep 48	(PW) 06 01 (tone code)*
Frequency of Beep 49	(PW) 06 02 (tone code)*
Frequency of Beep 50	(PW) 06 03 (tone code)*
Frequency of Beep 51	(PW) 06 04 (tone code)*
Frequency of Beep 52	(PW) 06 05 (tone code)*
Frequency of Beep 53	(PW) 06 06 (tone code)*
Frequency of CW	(PW) 06 00 (tone code)*
Send Message	(PW) 15 (message)*
Send Next message Slowly	(PW) 11*
Speed Select, Normal Rate	(PW) 12 (0-9 = 5-40 WPM)*
Speed Select, Slower Rate	(PW) 13 (0-9 = 5-40 WPM)*

DTMF DECODER

Access Mode	(PW) 57 06 (mode 0-5)*
Interdigit Time	(PW) 82 (0.1-9.9 sec)*
Mute Delay	(PW) 96 (.0-.9 sec)*
Mute Disable/Enable	(PW) 63 03 (0=disable/1=enable)*

IDENTIFIER

Callsign, Initial ID	(PW) 31 30 (message)*
Callsign, Initial ID Review	(PW) 34 30*
Callsign, Impolite ID	(PW) 31 32 (message)*
Callsign, Normal ID	(PW) 31 31 (message)*
Callsign, Normal ID Review	(PW) 34 31*
ID-triggered Macros:	
Impolite ID	(PW) 26 05 (macro name)*
Initial ID	(PW) 26 03 (macro name)*
Polite ID	(PW) 26 04 (macro name)*
Interval	(PW) 51 (.5-30.0 min)*
Reset Initial to Normal	(PW) 54*
Send Initial ID	(PW) 55*
Tail Message Select	(PW) 50 (0=initial/1=normal,tail number 0-15)*

LAND LINE CONTROL

Answer Modes	(PW) 64 (mode 1-4, 0=not answer)*
Control Line Timer	(PW) 79 (.1-54.6 min)*
Land Line Answer Message	(PW) 31 50 (message)*
Land Line Answer Message Review	(PW) 34 50*

LOGIC INPUTS

Logic Input 1 Hi-Lo	(PW) 26 20 (macro name)*
Logic Input 1 Lo-Hi	(PW) 26 21 (macro name)*
Logic Input 2 Hi-Lo	(PW) 26 22 (macro name)*
Logic Input 2 Lo-Hi	(PW) 26 23 (macro name)*
Logic Input 3 Hi-Lo	(PW) 26 24 (macro name)*
Logic Input 3 Lo-Hi	(PW) 26 25 (macro name)*
COR Input 1 Hi-Lo	(PW) 26 34 (macro name)*
COR Input 1 Lo-Hi	(PW) 26 35 (macro name)*
COR Input 2 Hi-Lo	(PW) 26 36 (macro name)*
COR Input 2 Lo-Hi	(PW) 26 37 (macro name)*
CTCSS Input 1 Hi-Lo	(PW) 26 40 (macro name)*
CTCSS Input 1 Lo-Hi	(PW) 26 41 (macro name)*
CTCSS Input 2 Hi-Lo	(PW) 26 42 (macro name)*
CTCSS Input 2 Lo-Hi	(PW) 26 43 (macro name)*

LOGIC OUTPUTS

Latched Off	(PW) 71 (list of outputs)*
Latched On	(PW) 70 (list of outputs)*
Momentary Off	(PW) 73 (list of outputs)*
Momentary On	(PW) 72 (list of outputs)*

MACROS

Append to Macro	(PW) 29 (macro name, command)*
Create New Macro	(PW) 20 (macro name, command)*
Erase Macro	(PW) 21 (macro name)*
Erase All Macros	(PW) 22 00*
List Macro in CW	(PW) 33 (macro name)*
Rename Macro	(PW) 27 (old name, new name)*

REPEATER OPERATION

Access Mode	(PW) 57 00 (mode 0-5)*
Activity Macros:	
Start Activity	(PW) 26 14 (macro name)*
Post Activity	(PW) 26 15 (macro name) *
Activity Counter/Timer	(PW) 45 (event 0-9,0.0-9.9 min delay)*
Courtesy Message	(PW) 31 10 (message)*
Courtesy Message Review	(PW) 34 10*
Courtesy Timer	(PW) 32 (0.0-5.0 seconds)*
Dropout Message	(PW) 31 13 (message)*
Dropout Message Review	(PW) 34 13*
Dropout Timer	(PW) 30 (0.0-5.0 seconds)*
Pre-Timeout Message	(PW) 31 16 (message)*
Pre-Timeout Message Review	(PW) 34 16*
Post-Timeout Message	(PW) 31 19 (message)*
Post-Timeout Message Review	(PW) 34 19*
Receiver #2-to-Transmitter Path	(PW) 63 82 (0=off/1=on)*
Timeout Timer	(PW) 40 (.1-54.6 min/000=infinity)*
Timeout Timer Reset	(PW) 10*

SECURITY

Control Operator Password	(PW) 92 (new control op password)*
Master Password	(PW) 93 (new master password)*
Privilege Level	(PW) 94 (root no., 0=control op/1=master only)*

TRANSMITTER

Disable/Enable	(PW) 63 00 (0=off/1=on)*
Key	(PW) 00 (.1-54.6 min/00=infinity/(nothing)=cancel)*

UTILITIES

Command CW Responses	(PW) 63 02 (0=off/1=on)*
Command Termination Control RX	(PW) 56 (00= req'd/0.1-9.9 sec after COR)*
Command Termination Repeater RX	(PW) 99 (00= req'd/0.1-9.9 sec after COR)*
Pause	(PW) 98 (1-255 sec)*
COR Pulsed-Triggered Macro	(PW) 26 17 (macro name)*
Count, Duration, Window	(PW) 47 0 (count,min.duration>window)*
Power-On-Triggered Macro	(PW) 26 00 (macro name)*

This is the end of the V1.02 manual.
V2.0 upgrade information follows.

(If your 6K isn't V2.0, you can upgrade it with a low-cost kit from S-COM.)

Thank you for purchasing the 6K Upgrade V2.0!

Enclosed you will find:

- A replacement RAM that also contains a battery and clock/calendar.
- A replacement EPROM containing V2.0 firmware.
- Update pages for the 6K manual.

You will need:

- A soldering pencil and solder.
- Two short pieces of bare wire for jumpers.
- A needle-nosed pliers.
- A small screwdriver or similar tool to extract ICs from sockets.

1. Disconnect power and cabling from the 6K.
2. Remove the push-on jumper (shunt) from the header marked "MEM". Discard it.
3. Remove integrated circuits U3, U4, and U5 from their sockets. Discard them.
4. Locate the 8-pin IC socket for U3, which is now empty. Install a wire jumper from pin 1 to pin 8. Install the other wire jumper from pin 5 to pin 6. Solder the two jumpers in place. (Note: Count the pins counter-clockwise.)
5. Carefully push the supplied DS1644 into the socket for U4. Carefully push the supplied V2.0 EPROM into the socket for U5. Be sure the ICs are correctly oriented in their sockets.
6. Initialize the controller by performing a cold start. (Press the INITIALIZE pushbutton and keep it pressed while you turn the power on. Release it when you hear the CW message.)
7. Additional information: The DS1644 module you installed contains a 32K byte RAM, a lithium battery, and a timekeeping circuit. When main power is lost, the battery inside the DS1644 maintains the data stored in RAM and also powers the timekeeping circuit. The original board-mounted lithium battery is no longer needed, and may be removed by unsoldering it from the board (if desired).
8. Update your 6K manual according to the supplied sheets.

NOTE: Along with the new features mentioned in the following pages, please note these additional improvements in V2.0:

1. The number of macros has been increased from 200 to 280, and the maximum storage capacity of each macro has been increased from 54 to 100 characters.
2. The Message Routing Codes have been improved so that you can decide whether a message should be mixed with receiver audio. IDs, for example, should be mixed; paging tones should not. Here are the changes in the codes:

9981 Route this message to the transmitter MIXED with receiver audio
9982 Route this message to the transmitter NOT MIXED ("in the clear")
9985 Route this message to the phone line MIXED with receiver audio
9986 Route this message to the phone line NOT MIXED ("in the clear")
9987 Unroute this message to the transmitter
9989 Unroute this message to the phone line

Select Anti-Kerchunker Parameters

Programs the “Anti-Kerchunk” *Key-up Delay* and *Re-Arm Delay* for the repeater.

- Users must key for the selected length of time before the repeater transmitter keys.
 - Once the *Key-Up Delay* is exceeded, the feature is disabled.
 - The anti-kerchunker is *Re-Armed* if no activity is present for a selected length of time after the repeater transmitter drops.
-
-

Command Form:

Command	Form	Data Digit
Select Key-Up Delay	(PW) 80 xx *	xx = duration = (00–99) = (0.0–9.9) seconds
Select Re-Arm Delay	(PW) 99 10 xx *	xx = duration = (00–99) = (0.0–9.9) minutes

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: Key-Up Delay is 0 seconds; Re-Arm Delay is 0 minutes

Examples:

If you want to require a one-half second key-up delay, enter:

(PW) 80 05 *

Unless changed, the anti-kerchunker will re-arm as soon as the repeater transmitter drops. If you want a 1.5 minute delay in re-arming, enter:

(PW) 99 10 15 *

To disable the anti-kerchunker, set the key-up delay to 0:

(PW) 80 00 *

Select Receiver Activity-Triggered Macros

Select Receiver Post-Activity Timers

Allows the programmer to execute macros based on activity detected by the receivers.

Receiver Post-Activity Timers delay the macro execution for a programmable length of time after last activity.

- Each receiver has its own *Start-of-Activity Macro*, *Post-Activity Macro*, and *Post-Activity Timer*.
 - The *Receiver Post-Activity Timer* starts each time receiver activity ends. When the timer expires, the macro associated with the receiver is executed. The timers require two data digits representing the delay. "00-99" equals 0.0-9.9 minute delay.
 - These macros execute based solely on receiver activity, and act independently of the transmitter paths that the receivers drive.
 - Be sure to set the corresponding receiver access mode for Receiver 1
-

Command Form:

Command	Form	Data Digit
Select RX1 Start-of-Activity Macro	(PW) 26 67 (macro name) *	not applicable
Select RX1 Post-Activity Macro	(PW) 26 68 (macro name) *	not applicable
Select RX2 Start-of-Activity Macro	(PW) 26 69 (macro name) *	not applicable
Select RX2 Post-Activity Macro	(PW) 26 70 (macro name) *	not applicable
Select RX1 Post-Activity Timer	(PW) 99 00 xx *	xx = duration = 00-99 = 0.0-0.0 minutes
Select RX2 Post-Activity Timer	(PW) 99 01 xx *	xx = duration = 00-99 = 0.0-0.0 minutes

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: No macros are assigned; Timers are 1.0 minute

Examples:

These macros execute based solely on receiver activity, and act independently of the transmitter paths that the receivers drive. The setting of the

corresponding receiver path to Tx1 determines when there is receiver activity even if the corresponding path is not enabled.

If Receiver 2 is a link receiver, for example, the link can be “knocked down” (disabled) after several minutes of link inactivity.

These receiver-driven macros should not be confused with the *Repeater Activity-Triggered Macro* feature, which requires that Path 1 (Receiver 1 to Transmitter 1) be enabled. See the *Enable/Disable Path 1 (RX1 to TX1)* command.

Enable/Disable Path

Enables or disables the various Paths.

- Path 1 connects Receiver 1 to the Transmitter.
 - Path 2 connects Receiver 2 to the Transmitter.
-

Command Form:

Command	Form	Default
Enable/Disable Path 1 (Rx1 to Tx1)	(PW) 63 81 x *	ON (enabled)
Enable/Disable Path 2 (Rx2 to Tx1)	(PW) 63 82 x *	ON (enabled)

Data Digit:

Digit	Meaning
0	OFF (disabled)
1	ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Select DTMF Priority/Scan

Selects the priority of the three devices feeding the DTMF decoder, including placing one or more devices into the scan list.

- Enter four digits from the table indicating Priority Level or Scan for each of the four devices.
 - You may not enter all zeroes, implying that no device has access to the decoder. You may not assign the same priority to more than one device, except for “scan” (5). You may assign priority “0” (no access) to up to 3 devices.
-
-

Command Form:

Command	Form	Data Digit
Select DTMF Priority/Scan	(PW) 89 (RX1, RX2, RX3, PH) *	0 = no access to DTMF decoder 1 = Priority 1 (highest priority) 2 = Priority 2 3 = Priority 3 4 = Priority 4 5 = Scan this device

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	all zeroes, or digit greater than 5, or multiple devices with same priority

Default Condition:

Device	Default
RX1	Priority 3
RX2	Priority 4
RX3	Priority 1
PH (“PH” refers to the phone line)	Priority 2

Examples:

You may re-arrange the priorities of the three receivers and phone line from the default condition, which assumes that RX3 is a control receiver with the highest priority. It assumes that the phone line control feature is second, followed by the repeater receiver (RX1) and then the link receiver (RX2).

In addition to assigning priorities, you may cause the DTMF decoder to sequentially scan certain (or all) devices. Scanned devices are checked for DTMF only if no priority devices are active. If DTMF is detected on a scanned device, the decoder will remain connected to the device until either the device goes inactive, the *DTMF Interdigit Timer* expires, or a priority device goes active.

The more devices you scan, the slower the response to DTMF will be. (Users may have to hold the first DTMF digit slightly longer to “capture” the decoder.) There are no priorities within the scan list; whichever device has DTMF first will capture the DTMF decoder.

If you wish to give the phone line top priority, RX1 next priority, and scan RX2 and RX3, enter this:

```
(PW) 89 2 5 5 1 *
```

(NOTE: The 6K supports two receivers, not three, so simply assign a low-priority code to RX3 in the command.)

Enable/Disable DTMF Long Tones

Turns ON or OFF the controller's ability to execute macros based on reception of long DTMF characters.

- Enter one digit, 0 for OFF (disabled), 1 for ON (enabled).
-

Command Form:

Command	Form	Data Digit
Enable/Disable DTMF Long Tones	(PW) 63 68 x *	0 = OFF (disabled) 1 = ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: DTMF Long Tone feature is OFF (disabled)

Examples:

A *Long Tone* is a DTMF digit sent by a user that lasts continuously for 3.0 seconds or longer. The controller can execute a different macro for each of the 16 possible long DTMF characters. This system is compatible with the ARRL's nationwide "LiTZ" (Long- Tone Zero) program, which asks amateurs to monitor for a 3-second DTMF "0" sent by a user who is in an emergency situation.

The macro is executed on the trailing edge of the DTMF character. Since the long tone is treated similar to a logic input by the controller, it becomes a stand-alone signal instead of a character for the command buffer. There must not be any other characters in the command buffer when the long tone is received. The long tone character itself will not be stored into the command buffer.

After you have enabled this feature, see the *Select DTMF Long Tone Macros* command for information on assigning the appropriate macros to the long DTMF characters.

Select DTMF Long Tone Macros

Assigns a macro to be executed by the Long Tone shown.

- Enter the password, the 4-digit root number, the macro you wish to have executed by the long tone, and the (*).
 - If the macro has fewer than 4 digits, enter leading zeroes
 - If you wish to prevent a macro from being executed that was previously assigned, enter just the password, the 4-digit root number, and the (*).
-
-

Command Form:

Command	Form
Assign Macro to Long Tone Zero	(PW) 26 50 (macro name) *
Assign Macro to Long Tone One	(PW) 26 51 (macro name) *
Assign Macro to Long Tone Two	(PW) 26 52 (macro name) *
Assign Macro to Long Tone Three	(PW) 26 53 (macro name) *
Assign Macro to Long Tone Four	(PW) 26 54 (macro name) *
Assign Macro to Long Tone Five	(PW) 26 55 (macro name) *
Assign Macro to Long Tone Six	(PW) 26 56 (macro name) *
Assign Macro to Long Tone Seven	(PW) 26 57 (macro name) *
Assign Macro to Long Tone Eight	(PW) 26 58 (macro name) *
Assign Macro to Long Tone Nine	(PW) 26 59 (macro name) *
Assign Macro to Long Tone A	(PW) 26 60 (macro name) *
Assign Macro to Long Tone B	(PW) 26 61 (macro name) *
Assign Macro to Long Tone C	(PW) 26 62 (macro name) *
Assign Macro to Long Tone D	(PW) 26 63 (macro name) *
Assign Macro to Long Tone Star (*)	(PW) 26 64 (macro name) *
Assign Macro to Long Tone Pound (#)	(PW) 26 65 (macro name) *

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: No macros assigned

Enable/Disable DTMF Decoder Mute

Turns ON or OFF DTMF muting between either receiver and the transmitter.

- Enter one digit, 0 for OFF (disabled), 1 for ON (enabled).
-

Command Form:

Command	Form	Data Digit
Enable/Disable RX1-TX1 DTMF Mute	(PW) 63 50 x *	0 = OFF (disabled) 1 = ON (enabled)
Enable/Disable RX2-TX1 DTMF Mute	(PW) 63 51 x *	0 = OFF (disabled) 1 = ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: All DTMF Decoder Mutes are ON (enabled)

Examples:

DTMF Muting is usually left ON (enabled) to prevent annoying DTMF digits from being repeated, and to prevent listeners from learning command codes.

If it becomes necessary to signal some device that is monitoring the transmitter, you may turn OFF the muting associated with the desired receiver(s).

Enable/Disable End-of-Transmission Command Execution

Allows commands to be terminated by ending the transmission (releasing user PTT). This is in addition to the usual (*) character.

- The (*) character will terminate a command in any case.
 - You may enable or disable this feature separately for each receiver.
 - If this feature is enabled, the command will be executed 0.25 seconds after the transmission ends.
 - Enter one digit, 0 for OFF (disabled), 1 for ON (enabled).
-

Command Form:

Command	Form	Data Digit
Enable/Disable End-of-Transmission Command Execution for RX1	(PW) 63 57 x *	0 = OFF (disabled) 1 = ON (enabled)
Enable/Disable End-of-Transmission Command Execution for RX2	(PW) 63 58 x *	0 = OFF (disabled) 1 = ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default condition: End-of-Transmission Command Execution is OFF (disabled) for all receivers; (*) character required to terminate all commands

NOTE: These commands replace the old “(PW) 56” and “(PW) 99” commands.

Examples:

Whether or not this feature is enabled, the (*) character will always terminate a command. This is particularly useful if an input signal keeps the receiver active after a user enters a DTMF command.

If the feature is enabled, users can simply enter a command and release the push-to-talk button instead of entering the trailing (*). The 0.25-second delay prevents a partial command from being accidentally executed if the user's signal momentarily drops.

Select From-Start-of-Transmission Timer

Allows controller to “disconnect” the DTMF decoder from a receiver if it appears no DTMF command will be entered during a transmission.

- The DTMF decoder is free to find another source of DTMF commands if the current user does not enter a digit within 5 seconds from start of transmission (See the *Select DTMF Priority/Scan* command).
 - Reduces DTMF “falsing”, since the DTMF decoder only listens during the beginning of the transmission.
 - Enter one digit, 0 for OFF (disabled), 1 for ON (enabled).
-

Command Form:

Command	Form	Data Digit
Enable/Disable From-Start-of-Transmission Timer for RX1	(PW) 63 64 x *	0 = OFF (disabled) 1 = ON (enabled)
Enable/Disable From-Start-of-Transmission Timer for RX2	(PW) 63 65 x *	0 = OFF (disabled) 1 = ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: From-Start-of-Transmission Timer is OFF (disabled) for all receivers.

Examples:

If this feature is disabled, the receiver will feed the DTMF decoder for the duration of the transmission (subject to its priority. (See the *Select DTMF Priority/Scan* command).

If this feature is enabled, the receiver will feed the DTMF decoder for the first 5 seconds of the transmission (subject to its priority). If a user wishes to enter a command and has already transmitted more than 5 seconds, he must unkey and re-key before entering the command. Once a DTMF digit is entered, the receiver will continue to feed the DTMF decoder for the remainder of the transmission.

Select Phone Line Answer Macro

Assigns macro to be triggered when the controller answers the phone line (Phone Line Answer Modes 2, 3, and 4).

- Enter the 4-digit macro name desired.
 - Use leading zeros if needed.
 - To delete the *Phone Line Answer Macro*, enter the command with no macro name [i.e., (PW) 26 16 *].
-
-

Command Form:

Command	Form
Select Phone Line Answer Macro	(PW) 26 16 (macro name) *

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	too many digits entered
? err 2	illegal digit entered

Default Condition: No macro is assigned to this function

Example:

If macro 1234 is to be executed when the controller answers the phone line (modes 2, 3, or 4), the command is:

(PW) 26 16 1234 *

Monitor/Talk Out Via Phone

Allows the control operator to monitor or join the repeater conversation.

- These features are accessible from the phone line when in *Phone Line Control Mode*.
 - Enter one digit, 0 for OFF (disabled), 1 for ON (enabled).
 - When the autopatch is dumped, the *Monitor/Talk Out* paths are disabled.
-

Command Form:

Command	Form	Data Digit
Monitor Receiver #1 (Rx1)	(PW) 63 23 x *	0 = OFF (disabled) 1 = ON (enabled)
Talk Out Transmitter #1 (Tx1)	(PW) 63 26 x *	0 = OFF (disabled) 1 = ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: All paths are disabled.

Examples:

The telephone caller (control operator) retains the DTMF decoder when monitoring or talking out. The *Select Phone Line Off-Hook Timer* command controls the length of the session. You may monitor the receiver, then enable and disable talk out on the transmitter, during a conversation on the repeater.

Key Transmitter (Timed)

Keys the Transmitter for a timed period.

- The transmitter will not key under this command if it has been disabled using the *Enable/Disable Transmitter* command.
 - Enter a 1-, 2-, or 3-digit number representing the amount of time the transmitter should key (in tenths of minutes).
 - Enter nothing (or 000) to cancel key request.
-

Command Form:

Command	Form	Data Digit
Key Transmitter (Timed)	(PW) 00 x yyy *	x = transmitter no. = 1 yyy = (001–546) = (0.1–54.6) minutes or yyy = [(nothing) , 0, 00, 000] = cancel key

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digits entered

Default Condition: Transmitter is not requested to key

Key Transmitter (Untimed)

Keys the transmitter until canceled.

- The transmitter will not key under these commands if it has been disabled using the *Enable/Disable Transmitter* command.
 - Enter one digit, 0 for OFF (cancel), 1 for ON (key).
 - The transmitter will remain keyed indefinitely, until canceled.
-
-

Command Form:

Command	Form	Data Digit
Key Transmitter 1 (Untimed)	(PW) 63 41 x *	1 = key 0 = cancel key

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Conditions: Transmitter is not requested to key.

NOTE: This command replaces the old command “(PW)00 000*”.

Enable/Disable Transmitter Minimum Unkey Delay

Enables or disables the transmitter minimum unkey delay.

- A *Minimum Unkey Delay* is normally observed on the transmitter to prevent it from unkeying between software keying requests. If this delay is disabled, the transmitter may drop out between messages or other activities that require keying.
 - The delay may be disabled in special applications (such as half-duplex linking) where fast unkeying is desired.
-
-

Command Form:

Command	Form	Data Digit
Enable/Disable TX1 Minimum Unkey Delay	(PW) 63 31 x *	0 = OFF (disabled) 1 = ON (enabled)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Conditions: *Minimum Unkey Delay* is ON (enabled)

Set Clock and Calendar

Sets the clock and calendar.

- Enter all parameters shown below each time that you set the *Clock and Calendar*.
 - All parameters consist of two digits except the day-of-week, which is one digit.
 - The year parameter is needed for leap year correction.
 - The clock and calendar is set when you release the (*) button.
 - Seconds are automatically set to 00.
-

Command Form:

Command	Form	Data Digit
Set Clock and Calendar	(PW) 25 (year, month, day-of-month, day-of-week, hour, minute)*	from table below

Data Digit	Explanation
00-99	year
01-12 (January is 01)	month
01-31	day-of-month
0-6 (Sunday is 0)	day-of-week
00-23 (24-hour format)	hour
00-59	minute

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal parameter: any lettered key; month = 00 or greater than 12; day-of-month = 0 or greater than 31; day-of-week greater than 6; hour greater than 23; minute greater than 59.

Default Condition: 00:00:00 on Wednesday, January 1, 1993.

Example:

Let's set the clock to 6:02 PM on Saturday, March 21, 1992.

The year is 92, the month is 03, the day-of-month is 21, the day-of-week is 6, the hour is 18, and the minute is 02. The entire command is:

(PW) 25 92 03 21 6 18 02 *

Adjust Daylight Savings Time

Forces the clock to add or subtract 1 hour.

- This command simplifies the semiannual job of resetting the clock for customers affected by Daylight Savings Time. Instead of resetting the entire clock and calendar, use this command to add or subtract one hour.
 - Don't use the "fall back" command between midnight and 00:59 AM. Otherwise, the hour will change to 23 (11:xx PM), but the day won't roll back. You will gain another day at midnight.
 - Don't use the "spring ahead" command between 11:00 PM and midnight. Otherwise, the hour will change to 00, but the day won't roll forward. You will lose a day.
-

Command Form:

Command	Form	Data Digit
Adjust Daylight Savings Time	(PW) 48 x *	0 = "fall back" (subtract 1 from hours) 1 = "spring ahead" (add 1 to hours)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: None

Example:

To set the clock 1-hour ahead, enter the command:

(PW) 48 1 *

To set the clock 1-hour behind, enter the command:

(PW) 48 0 *

Run-Time Variables

Run-Time Variables (RTVs) are small code groups that you place into a message to be expanded at “run time” (the instant the message is actually transmitted by the controller). The message handler recognizes run-time variables because they always begin with 98.

When the message handler encounters an RTV, it forms the appropriate message and transmits it in place of the RTV code. You could, for example, announce the time or date as part of an ID, autopatch termination, or other occasion. You may precede and/or follow the RTV with other messages, routing codes, and so on. RTVs may be placed in succession to form a single expression.

Run-Time Variables		
Run-Time Variable	Meaning	Example
9810	hour & minute, 12-hr format, CW	2 45
9811	AM/PM, CW	PM
9812	hour & minute, 24-hr format, CW	14 45
9813	day of week, CW	WED
9814	month, CW	JAN
9815	day of Month, CW	1

A feature of the clock and calendar RTVs is that the current time and date are read and stored at the first RTV encountered in a message. If the time or date “rolls over” during the message transmission, it will not affect the time or date being sent. The real-time clock and calendar features leap-year correction.

Here are some ideas: To send the time and AM or PM, enter

(PW) 15 9810 9811 *

You would hear “two forty-five PM” or something similar.

You can create similar commands to send “today is (),” “the date is (),” and so on.

Note: It is not necessary to place the control code 9900 in front of CW run-time variables. The RTV automatically inserts the control codes into the message. However, you must enter control codes *after* the RTV if you have a different type of message to follow.

Scheduler

The *6K Controller* features a powerful Scheduler program that accepts up to 100 time/date *Setpoints*. Each setpoint can be programmed to execute a macro based on the month, day-of-month, day-of-week, hour, and minute of the real-time clock and calendar, e.g. midnight, December 31st. *Wildcards* can be used to program recurring setpoints, e.g. 9:00 AM on the first Saturday of each month.

The setpoints are compared to the real-time clock/calendar at the start of each new minute. If a match is found, the setpoint's accompanying *Macro* command is executed.

Since the real-time clock has a lithium power source, timekeeping is not affected by loss of main power.

Leap years are automatically adjusted. The real-time clock and Scheduler are Year-2000 compliant.

Create a Setpoint

Loads a setpoint into the Scheduler program.

- You must enter all parameters required by this command. You may force the scheduler to ignore the month, day, hour, or minute by entering the *wildcard* code, 99, for that particular parameter.
- The Scheduler supports 100 setpoints numbered 00 through 99. You may create up to 10 setpoints that execute at the same minute. If more than one setpoint executes at the same minute, the setpoints will be executed with the lowest numbered setpoint first, the next higher setpoint second, and so on.
- If the controller loses main power, timekeeping will continue; however, setpoints will not be executed, since the microprocessor will be down. Setpoints missed during the power failure will not be executed when power returns.

Command Form:

Command	Form	Data Digit
Create setpoint	(PW) 28 (setpoint number, macro, month, day, hour, minute) *	from table below. (Use Day Code Table for day parameter.)

Data Digits	Explanation
00-99	setpoint number, two digits
xxxx	macro, 4 digits
01-12 or 99	month, 2 digits or <i>wildcard</i>
01-68 or 99	day, 2 digits (see Day Code Table)
00-23 or 99	hour, 2 digits or <i>wildcard</i>
00-59 or 99	minute, 2 digits or <i>wildcard</i>

Scheduler Day Code Table

Day Code	Explanation	Day Code	Explanation
01-31	calendar day-of-month	54	2nd Saturday of month
32	weekdays (Mon-Fri)	55	3rd Sunday of month
33	weekends (Sat-Sun)	56	3rd Monday of month
34	Sundays	57	3rd Tuesday of month
35	Mondays	58	3rd Wednesday of month
36	Tuesdays	59	3rd Thursday of month
37	Wednesdays	60	3rd Friday of month
38	Thursdays	61	3rd Saturday of month
39	Fridays	62	4th Sunday of month
40	Saturdays	63	4th Monday of month
41	1st Sunday of month	64	4th Tuesday of month
42	1st Monday of month	65	4th Wednesday of month
43	1st Tuesday of month	66	4th Thursday of month
44	1st Wednesday of month	67	4th Friday of month
45	1st Thursday of month	68	4th Saturday of month
46	1st Friday of month	69	5th Sunday of month
47	1st Saturday of month	70	5th Monday of month
48	2nd Sunday of month	71	5th Tuesday of month
49	2nd Monday of month	72	5th Wednesday of month
50	2nd Tuesday of month	73	5th Thursday of month
51	2nd Wednesday of month	74	5th Friday of month
52	2nd Thursday of month	75	5th Saturday of month
53	2nd Friday of month	99	every day (<i>wild card</i>)

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: No setpoints exist.

Example:

To execute macro 1234 every hour, on the hour, every day, every month, enter the following:

(PW) 28 00 1234 99 99 99 00 * (Setpoint 00)

To execute macro 1234 every day at 6:15 AM, every month, enter the following:

(PW) 28 01 1234 99 99 06 15 * (Setpoint 01)

To execute macro 1234 at 10:30 AM on the weekend (Saturday and Sunday), every month, enter the following:

(PW) 28 02 1234 99 33 10 30 * (Setpoint 02)

To execute macro 1234 at midnight every Saturday in June, enter the following:

(PW) 28 03 1234 06 40 00 00 * (Setpoint 03)

To execute macro 1234 at noon on April 15th, enter the following:

(PW) 28 04 1234 04 15 12 00 * (Setpoint 04)

To execute macro 1234 at 5:00 PM (17:00) on the first Thursday of every month, enter the following:

(PW) 28 05 1234 99 45 17 00 * (Setpoint 05)

It is not necessary to fill in each setpoint starting from 00. Unprogrammed setpoints that cause gaps in the sequence will be ignored by the Scheduler.

You can minimize the number of programmed setpoints with creative programming. For example, you may wish to execute a macro at 10:00 PM each day of the week *except* Sundays. Instead of creating six setpoints for Monday through Saturday, create just two: one for Saturday, and one for weekdays.

Suggested uses for the Scheduler include changing the repeater mode from carrier to CTCSS depending on time of day; disabling the autopatch during busy times; starting a net with a tone page; and adding greetings or announcements on holidays or special events.

Delete a Setpoint

Deletes a setpoint from the Scheduler program.

- To delete a setpoint, enter the two-digit setpoint number.
-
-

Command Form:

Command	Form	Data Digit
Delete a Setpoint	(PW) 28 (setpoint) *	00-99, setpoint number

Acknowledgment: Sends OK

Errors:

Error	Meaning
? err 1	wrong number of digits entered
? err 2	illegal digit entered

Default Condition: Setpoint does not exist.

Example:

To delete setpoint 14, enter the following:

(PW) 28 14 *

NOTE: The most recent firmware version for the 6K is called V2.1. One command was added to the firmware in this version:

Hook flash (PW) 63 16 1 *

This command causes the phone line, if engaged, to go on-hook momentarily. This is similar to someone pressing and releasing the hookswitch button on a telephone.